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The Journal of SOCIAL, POLITICAL AND ECONOMIC STUDIES

Roger Pearson
General Editor
Dwight D. Murphey
Associate Editor

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Contents

Some Thoughts on the Columbia Disaster and How to Proceed from Here
Klaus P. Heiss 389

Proliferation of Weapons of Mass Destruction: Iraq and Iran
Gawdat Bahgat 423

An Examination of Gender Asymmetry in Divorce: an Extension of Fisher's Thesis
Wade C. Mackey and Ronald S. Immerman 451

China – Emerging Hegemony A Speculative Essay
Seymour Itzkoff 487

Book Reviews:
The Illusion of Victory: America in World War I; Cosmic Legacy: Space, Time, and the Human Mind 497

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Some Thoughts on the Columbia Disaster and How to Proceed from Here

Klaus P. Heiss[1]
Washington D.C.

The Space Shuttle 'Columbia' disaster in February of this year has led to a basic re-examination of the question of human space flight and how best to explore the solar system and worlds beyond. In April of this year NASA presented its Long Term plan for Space Exploration. A close reading of which would have one conclude that NASA was about to abandon Space exploration by humans in preference of robotic missions and in this process also dump the Space Shuttle and initiate a so-called 'Orbital Space Plane' that was but a reusable Apollo type capsule launched on an expendable rocket – a 'vision' soundly rejected in the early 1970s.

Provoked by this 'stealth' termination of Space exploration by humans the author composed the Memorandum published herein, addressed to Vice President Cheney and the White House, in which he argued that not only should the exploration of Space by humans continue, building on the half-completed reusable Space Transportation system (the Space Shuttle of today), but a historic new goal for human Space exploration could be set, to be achieved within a decade and at a cost of less than a doubling of the steadily shrinking NASA budget: the establishment of the first permanent human settlement on the Moon.

The author further suggested that an internal assessment effort of say three to four months would confirm the basic claims made herein and become the basis for a Presidential decision to such effect. Indications are that such a decision is forthcoming – dramatically reversing the course set by the Space bureaucracy a few months ago.

Key Words: NASA; SIG; Space Shuttle; Columbia; Space Exploration; Thrust Assisted Orbiter Shuttle; Space Transportation system.

Introduction

Much has been said about the promise and costs of the Space Shuttle and of Space exploration. It is sad that it takes tragedy to focus society on the core issues of human enterprise and on the importance of space to America's future – in Space and on Earth. The "sacrifice" of the Columbia disaster threatens to be the pivotal event to renew the United States commitment to manned Space exploration and enterprise.

First an historical note: The world will soon see the launch to and

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return from space of the first astronaut launched by China. Without "Columbia" we might have seen – and still might see – a true reversal of roles at this juncture of history. In the 15th century China was the world's leading, dominant nation, the "center" of the world and the world's leading shipbuilding nation as well. Chinese voyagers are said to have explored the coasts of Asia, Africa and (if one is to believe recent speculations by British investigators) even the Americas. In the 15th century the future of mankind was for China to take, but it was Europe who achieved. The reason for China's failure may have been some quirk in the decisions of China's emperors and empresses – possibly the eunuch advisors to some Empress who may have asked the "obvious" question: "why spend all this treasure to visit wastelands on the rims of civilization?" As they say, the rest is history: it was Europe, not China, that brought modern civilization to the rest of mankind in centuries that followed.

We are today at a frighteningly similar junction, with bean-counters and administrators running our governmental affairs and "intellectuals" writing away in all their brilliance of the benefits of static income redistribution from the "rich" to the "poor". Had we followed their advice in eons past we would still be sitting in the caves, redistributing the catch of the day from those successful in the hunt to those who stayed home in their caves.

But in addition to the overriding rationale for Space exploration and enterprise, there were and are also strict utilitarian (economic) reasons for the Space Shuttle and Space enterprise. I was in charge of the independent assessment effort of the Space Transportation System directed by the White House for NASA in 1970 through 1972, so let me share with the readers the rationale put forth at that time and – equally important – how that rationale compares with the "facts" thirty years later. My conclusion: is that we made the right decision then, and we make the right decision again today if we continue to pursue space exploration utilizing reusable vehicles to give us access to space and manned space craft for exploration beyond that. I will outline first the cost-efficiency case made in 1971, and I will then offer my analysis of what went wrong along the way. That done I will talk about the promise of Space we saw in 1971 – and still see today – and the clear, single goal

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of manned space flight.

I: The Rationale for the Space Shuttle Decision in 1971.

Contrary to perceptions, which have in no small part been bandied about even by NASA bureaucrats, the case for the Space Shuttle and also for the Space Tug (that would provide a fully reusable space transportation capability to all earth orbits) was NOT built on transportation cost savings. All presentations made by us on this issue started out by saying that "the Space Shuttle can NOT be justified solely with the narrow argument of transportation cost savings." Indeed, it is this statement and the logical exposition of the real case for the Shuttle that won me the award to do the independent outside assessment by NASA in 1970: a $3 million contract, limited explicitly to five pages of substantive exposition and a full day cross-examination as to the rational.

After the cross examination of my team's assessment was over (a Tuesday of a full week of competing proposals), I knew my team had won – the contract and the logic for the Shuttle and Tug: the program would be approved, and a new age would be opened for the United States in Space exploration and enterprise:

So what was the logic for having a Space Shuttle and Tug – other than to facilitate manned Space flight?

1. First: Space Transportation Costs. The very first table in our executive summary as well as well as in the main report submitted by us to NASA stated that New Expendable (rocket) systems would be cheaper in terms of life-cycle costs: some $11 billion for Expendable vehicles vs. $12 billion-plus for the Space Shuttle and Tug. These amounts did not include manned Space flight missions.

However one "massaged" the NASA and DoD mission models (we reduced the mission numbers given to us by the agencies by up to 67%) there was no way to "justify" the Space Shuttle based on transportation costs over a 10 year, 20 year or even "infinite" time horizon.

2. "Payload Effects": whereas transportation costs were at best a "draw," the real reason for reusable space transportation capabilities (to orbits of all kinds, including lunar orbits) was to be found in the vast effect these novel capabilities would have on the very conduct of space

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missions, their reliability and capabilities. This is what we stated then and what we mean by these effects:

2.1. The ability to revisit satellites in earth orbit will allow for the maintenance, repair and updating of these instruments and spacecraft. Transportation costs constitute only one-third of total space program costs. The rest has to do with spacecraft, instruments, data and their processing, in space and on the ground.

2.2. The foregoing will allow us, indeed will force us, to standardize spacecraft and space systems at a subsystem level. This idea was revolutionary at that time and still has to be implemented today – or could be implemented if we truly had a reusable space transportation capability to all these orbits. The savings across the space program would be dramatic and radical in scientific, commercial and military space missions. Indeed, estimates were that these costs could be cut by up to 67% across small, medium and large spacecraft. Standardization would be required if for one reason: to facilitate the repair and updating of these spacecraft at a subsystem level, performing tasks even test pilots may be capable of in the space environment without graduate degrees in aeronautical or any other engineering field. Only a select few space missions were found to be outside the scope of such standardization. Instead of handcrafting each satellite like ultra-expensive Swiss clockworks, the age of standardization would have been introduced in space exploration, just as it was in the decades after 1970 in car manufacturing and many other industries.

2.3. Simultaneously, reliability and assurance of service would be increased dramatically. For programs essential for the security of the United States, these requirements of assurance of service in orbit require an extraordinary expenditure of funds and assets.

For example for assured global coverage, at least three multibillion dollar spacecraft are required in geo-synchronous orbits (so as to 'cover' all of the Earth) and each requiring an on-station replacement unit right next to each satellite (in case that specific satellite were to fail, for 'instant' replacement).

Furthermore, to assure the replacement of each of these replacements (in case the main unit or the replacement unit in orbit were to fail) requires a replacement unit on the ground ready for launch, so that

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the replacement unit(s) that are in orbit can be replaced in orbit.

Last and least, three more units have to move through the production lines to allow replacement of the units on the ground in case they are needed.

The result: a need for a total of four times the nominal capability required for operating on-station in orbit.

Indeed, we should be grateful for such "paranoia"; the absence of such assurance of service could even lead to war.

With an ability to revisit, repair and update, assurance of service is increased to levels customary in ground-based operations.

At the same time, the number of spacecraft needed for such assurance of service is drastically reduced. The reason for such reduction is that with the ability to repair, revisit, update and refurbish these units in orbit 'real time' the need for 'in orbit' standbys is totally changed: rather than complete satellites in triple redundancy spares, repairs and inspections at a subsystem level can lead to assurances of service similar to those experiences for military and commercial systems on Earth (not that such assurances always are fulfilled...).

Assurance of 'twelve sigma' reliability may be achieved, at least in theory: the actual record of the US defense department has been woefully distant from these promises, e.g. during the two to three year stand-down in the mid 1980s due to the Challenger disaster.

The level of assurances sometimes are only exceeded by the level of incompetence of SIG-Space – based on the record of the past decades.

2.4. Ability of in-orbit modernization: with a subsystem design, replacement and repair capability, the prospect exists of updating these expensive assets in space, rather than replacing whole systems or, worse, letting old technology linger in space providing obsolete services.

3. Enabling New Space Missions: in order to give as conservative an evaluation of the new Space Transportation System as we can, we excluded manned missions. We did not want to rationalize the Space Shuttle solely on the basis of man in space. It would tilt the analysis much too much in favor of the Space Shuttle.

So we set out to define an entirely unmanned space mission program. We made use, however, of the extensive new capabilities that the Space Tug and Space Shuttle opened up: structures that were larger

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than could be carried by any expendable system; and that were standardized and designed for repair, replacements, updates, and maintenance. We also included entirely new classes of spacecraft, be they for science, commerce or defense, whether in Low Earth Orbit, intermediate orbits or far beyond up to Geo/synchronous orbits. Dozens of new space application missions where designed and outlined for NASA, the DoD and private enterprise to pursue once the Space Shuttle and Tug were fully operational. Here are but a few examples in each of the areas:

3.1. Space Science: one of our first visits in Princeton was to the astronomy department, chaired at that time by Prof. Spitzer. The result of these meetings was what today is known as the Hubble Space Telescope, already mentioned above. Were it not for the unique capabilities of the Space Shuttle, this telescope could never have been built, launched, repaired, maintained and modernized, up to and including entirely new capabilities not envisioned at the inception of this program.

This single project and the myriad of discoveries that have since been made with this magnificent instrument justify the entire Space Shuttle program, as well as the tragic death of the crews of Challenger and Columbia: what nobler cause than to die in pursuit of answers to the ultimate questions of why we exist, where we came from and where the journey will take us in the future? Without Hubble we would be grappling blindly in a sea of ignorance, devoid of the magnificent data Hubble has and will continue to provide.

But like Hubble we had defined half a dozen other scientific space craft, some in LEO, some in HEO and some in GEO, ranging from radar to infrared to multi-spectral instruments of a size and capability hitherto unknown and unimaginable.

3.2. Commercial Applications: communications and remote sensing were the principal uses foreseen. Some of these applications would develop with or without the Space Shuttle, such as a vast range of communications and navigation satellites: e.g., GPS, a variety of global resources sensing satellites, and low and high earth orbit communication satellites at a variety of frequency bands. Many of these have come about by now, although some still remain to be implemented as market

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conditions permit.

However, we also foresaw an entirely new class of satellites, with vastly expanded capabilities, requiring precisely the same type of capabilities and engineering approach as the one used for the Hubble Space Telescope. As just one example: we envisioned a new generation of communication platforms in geo-synchronous orbit. These would have on-board switching capabilities, vastly expanded power requirements, and on-board data processing and storage. Tens of thousands of spot beams would provide satellite-to-satellite optical and laser communications that, once deployed, would allow point-to-point communications to any place in the world, even without any ground communications capabilities, allowing access to any and all data and information bases with simple, handheld devices.

Today, some of these capabilities have been realized with what we now call the 'internet". However, our vision went well beyond that, inasmuch as these space-based capabilities were not subject to any totalitarian government controls and were able to make available the complete Library of Congress as if entering that Library, its catalogues and volume retrievals "on site". We projected these capabilities to bring about the collapse of totalitarian systems, which to a large extent are built on the control of information. Today we are still a long way from that lofty goal, with many a trend recently taking us in a somewhat different direction of more control and less access.

Because of the size of these platforms, their cost and the predictability of constant technological change, direct access to these platforms, their repair, updating, maintenance and modernization was absolutely essential. So, too, was the assurance of their high reliability of 99.999 plus percent.

For remote sensing of the earth's resources, we envisioned a Global Resources Information System (GRIS), described in detail in the NRC papers of the Snowmass meetings of 1974. The effect on the distribution of world food supplies through the commodities markets alone accounted for billions of dollars in annual benefits. Environmental, energy, geologic and other resource observations benefited as well, even including such applications as archeology. Many of these have by now become reality, since they can also be achieved with smaller spacecraft

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and do not require the capabilities of the Space Shuttle and Tug system.

3.3. Defense Applications: at least one-third of all applications foreseen for the new STS were defense-related. They included some of the applications realized since then in navigation (GPS), in observations, and in communications, although what has been done does not go so far as would have been possible if we had truly developed the full Shuttle and Tug capabilities. Those would have provided vistas as to expanded uses of space very similar to those cited above for commercial uses.

However, two outstanding missions that shed light on the effectiveness and desirability of the Space Shuttle deserve special mention: kinetic- and /or laser-based defense against ballistic missile attack. Building on the considerations of "Bambi" and the seminal paper by Max Hunter, a member of our team, in 1968 showing in principle the technical feasibility of a space-based laser defense against ballistic missile attacks, we included both options in our 1971-72 analyses. On cost-effectiveness alone, these two missions – although not necessary for a positive Space Shuttle decision – would have added significantly (especially if combined with a Space Tug) to the uses of the Shuttle and its defense capabilities. With them, it would have been possible to revisit, update and modernize defense uses globally against weapons of mass destruction.

3.4. Not included was a truly spectacular vision of future energy supplies from space to earth. Large Solar Power Satellite Platforms of up to 100 square miles in area were first proposed by Peter Glaser of Arthur D. Little. One such platform alone will be able to supply up to 10 GW of electric power to any point on Earth.

3.5. Also not included in the analyses were any manned space flight missions such as a Space Station, or Lunar missions or missions beyond. The reason, once again, was not to commingle the obvious missions and requirements of manned space flight with an analysis of whether a Shuttle and Tug were needed even in the absence of such missions. Indeed, the new horizons that manned flights would open are truly astounding.

Analyzing literally hundreds of different space program scenarios, with all mixes of foreseeable space missions and applications, we concluded at the end of January, 1972, that indeed the development of a

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Space Shuttle and Space Tug was in the interest of the United States; and that this could be done at a substantially reduced cost from the original plans of NASA, which involved a two-stage fully reusable design – roughly a 707 on top of a 747 taking off vertically with internal hydrogen tanks, etc. The country could be saved billions of dollars in the development phase cutting the RDT&E costs by 50% or more, and allowing a cost-effective new range of space operations and uses. This result was given to the NASA Administrator in my Memorandum of October 29, 1971 (which was still limited to examining two-stage designs only and was submitted in time to assure consideration in the Final Design Selection process set for early November) and in a three-volume report and separate Executive Summary of January 1972. These documented the extensive work done by our group in Princeton with support from the Aerospace Corporation (Mission modeling) and the Lockheed Missile and Space Corporation, which was (and still is) the leading contractor for military payloads.

The explicitly stated risk of Shuttle Missions: a one-in-fifty likelihood of failure.

Today, thirty-plus years later, I would not change a single sentence, conclusion or recommendation made in 1971, except to emphasize even more the concluding observations to NASA: that the economic basis for the Space Shuttle and Tug were sound and solid, so long as NASA and the United States had an active space program along the scaled-back scenarios we outlined.

It never would have occurred to us that NASA and the nation would abdicate the pursuit and conquest, indeed domination, of Space.

II: A 30-Year Road to Disaster

4. The initial Space Transportation System Recommendations of 1971.

The 1972 decision to proceed with a new Space Transportation System – comprising the TAOS Shuttle and the Space Tug – was the last significant, courageous and strategic space program decision. It assured an aggressive US space strategy for the rest of the century and well into the next millennium. This was to have been at an affordable budget profile substantially less than that expended on the Apollo program of

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the 1960s, the vision for which President Kennedy and his generation will be remembered in millennia to come.

Without summarizing the entire 1971/72 report, here are the salient technical transportation components contained within it:

4.1. TAOS instead of Two-Stage Fully Reusable Shuttle:

The TAOS Orbiter Shuttle represented a substantial reduction in development costs, risks and schedules over the two-stage fully reusable Orbiter and Booster desired by NASA. The estimated development costs were reduced by a factor of three-fourths (from $50 to 60 billion in 1970 dollars to $15 to 20 billion for TAOS, a savings of at least $40 billion.

4.2. A reusable Space Tug:

It was intended that access be assured by all earth-orbit missions to the new STS and to its new philosophy of payload standardization for in-orbit repairs, refurbishment, updating and rescue.

4.3. An Ambitious Unmanned Space Missions program was included, involving:

4.3.1. All "conventional" DoD programs currently deployed;

4.3.2. Two novel DoD missile defense missions, one "kinetic" (then called 'killer bees'), and one laser-based (Max Hunter's concept of 1968);

4.3.3. "Conventional" science and commercial programs such as communications, observations, navigation and life sciences programs;

4.3.4. An entirely new class of science and commercial space capabilities such as

4.3.4.1. Large Astronomy Observation platforms; e.g., the Hubble Space Telescope and several others that availed themselves uniquely of the new STS capabilities; and

4.3.4.2. Large Space Communications platforms of entirely new dimensions in geosyncronous orbit, accessible by the Space Tug, and allowing global point-to-point communications without any ground networks. One such project envisioned making available the entire Library of Congress via these platforms to anyone with simple handheld devices.

4.4. Enabling whatever Manned Space Program the US might wish to pursue as a "side benefit" of these capabilities.

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Had NASA and the nation fully pursued these programs and fully developed the STS vision of the early 1970s in the afterglow of the Apollo program's achievements, the dominance of the United States in space would have been absolute. Some of these programs have immensely contributed to changing the strategic perceptions and relations in any case, even without their full implementation (e.g., SDI – missile defense). Others, indeed most, are still not implemented.

The fact that other nations have been even more laggard in the pursuit of space enterprise and exploration is no excuse for the US to have failed so miserably in advancing beyond the known and doable of the late 1960s. The course charted then still remains to be taken, most notably in manned space flight. Yet, NASA and the process of the Space Interagency Group have managed to botch even the modest programs actually pursued since then. This is the reason the United States is in the precarious state it is in today. It is a situation that requires leadership, not timid extrapolations from a morass of inactivity and accounting acrobatics.

The road to the current disastrous state has had the following 'milestones,' although (as we will see) not all of them have been setbacks:

5. Early Open Questions and Compromises 1972

After having identified the TAOS (Thrust Assisted Orbiter Shuttle) as the most cost-effective of the "hybrid" Space Shuttles, I assembled the top experts from industry and NASA in Princeton in June/July of 1971. We had to meet in a dilapidated hotel along Route 1, because university grounds at that time were "off-limits" to the "military-industrial complex". During that week of meetings, all the critical issues came to light. The meeting pitted all the different engineering approaches and groups against one another in a truly historical debate that sometimes reached rather high-decibel levels. What was most remarkable then (and may I say, since) where the following:

5.1. Solids vs. Pressure-fed "assists" to the Shuttle at take-off: having eliminated the need for a 747-size reusable booster as envisioned by NASA in its original desires submitted to us for evaluation, we had to provide the "extra lift" with parallel rocket assists. Two principal options were considered: either solid rockets, such as those produced by Thiokol for expendable rockets, or (like the main external tank) two additional

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pressure-fed rockets using the same fuel (oxygen and hydrogen) as the Main Space Shuttle Engines.

The former had an "irreducible risk." Among other things, this related to simultaneous ignition and the inability to cut off such ignition if problems developed during launch. By contrast, pressure feds not only could be shut-off in case of emergency, but with "cross-feed" from the other tanks (the main tank and/or the other parallel burn booster) all engines could be fed from whatever tank(s) were operable. Indeed, of all the Shuttle launches, the most impressive was the one that did not take off after the SSMEs (Shuttle Main Engines) had ignited but before the Solids had ignited, quite a feat. The worst Shuttle accident has not happened: ignition of only one of the Solids and a "cartwheel" of the Shuttle and tanks and solids right on the take-off stand.

Yet this is what we discussed at those meetings, leaving the choice open. The reason: pressure-feds with cross-feed had not been tested operationally on such a scale and required an additional $500 million in RDT&E costs when compared to solids.

Another drawback of Solids: they would double the cost per launch. The consensus: whatever decision NASA made on Solids vs. pressure-feds, we would move rather quickly to add pressure-feds to Shuttle operations, simply to reduce risk and the high cost per flight.

5.2. Thermal Tiles vs. Metallic Composites Heat Shields: the other big issue in these meetings was how to provide for the tremendous heat arising during re-entry into the atmosphere. Grumman was considering an ingenious scheme related to tiles. The other major option was to develop new metallic/composites able to withstand these stresses and environs.

Again, the tiles approach was more immediate and required less new materials development. The metallic protection, while requiring a significant materials development and testing program, would dramatically reduce turn-around times, refurbishment needs and thereby launch costs and times.

5.3. Space Shuttle Main Engines: with ignition at lift-off and burn all the way to earth orbit, significant new requirements were imposed on rocket engine technology. Indeed, the development and total success of the SSMEs to this date constitutes the major technological achievement

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in the Space Shuttle program, a feat no other spacefaring nation has accomplished to date. Yet, the uncertainties at the meetings in that June/July week were significant. The RDT&E needs were inescapable and hence committed to.

5.4. Gradual Evolution of the Space Shuttle to a fully reusable Spacecraft: NASA was about to be forced into an unpleasant compromise: namely, to give up on its dream of a fully reusable, two-stage Space Shuttle (an incredible technological challenge) in favor of this "hybrid" TAOS approach. Therefore, a core component was to keep alive the possibility of a gradual evolution toward a fully reusable Space Shuttle with future procurements. This vision was as follows:

5.4.1. Initial fleet-size and subsequent procurements: Based on launch requirements and on the anticipated "attrition," material and technical obsolescence, an initial procurement of five Orbiters was proposed. Additional Shuttles were to be procured at a rate of about one a year, for a total of between nine to twelve for the initial decade of full operations.

5.4.2. Two launch sites – ETR (Kennedy Space Center) and WTR (Edwards in California for polar orbit launches) were anticipated.

5.4.3. Gradual Technology Upgrades: As the experience and technology progressed, the Solids would certainly be replaced by pressure-feds, and the tiles with metallic composites. The payload capacities could be dramatically increased with, for example, a parallel launch of two Shuttles simultaneously, with the tanks between them, vastly expanding the mass and size of payloads to be transported to LEO.

5.4.4. Evolution toward a Fully Reusable Shuttle: Ultimately even more radical innovations could evolve from the TAOS, such as the "Stage and A Half" envisioned by the team member Max Hunter, with up to sixteen Shuttle engines and delta wing-shaped fuel tanks attached (and recovered).

6. The October 1971 Compromise on Solids vs. Pressure-feds:

As the Shuttle design decision by NASA came to a climax in late 1971, I decided to write NASA the Memorandum as to our conclusions about the Space Shuttle, configurations and options. That input was needed before NASA made a possibly irreversible decision in early

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November 1971.

In addition to the TAOS configuration choice, I had come to the conviction that, clearly for reasons of cost-per-flight, risk-of-flight and intact abort requirements, the ideal option was the pressure-fed version of TAOS: every aspect of Space-flight operations indicated this preference. Yet, I was convinced that giving NASA a "choice" between Solids and Pressure-feds rather than an outright recommendation for pressure-feds would invariably lead to NASA choosing Solids, for two "reasons": first, Solids meant $500 million less in funding requirements in the '70s and, second, Thiokol was from Utah and produced Solids and so were the Chairman of the Senate Committee presiding over these issues (Senator Moss) and the Administrator of NASA. No other component subsystem of the Shuttle could be produced there. So NASA would invariably come to a preordained (wrong) conclusion in this matter.

Having drafted the Memorandum, I went to see Oskar Morgenstern, my professor, to have him co-sign the memorandum. After I explained the need for such an input and the various attendant open issues, Morgenstern would only agree to co-sign the Memorandum with the two options left open. I did not have the courage (or gumption) to send the Memorandum without his support. In 2002 many years later, I learned upon a visit to Princeton at dinner with the 1971 Science Advisor under Nixon, Mr. Davis, that Dr. Fletcher had come to him in early 1972 on this very issue. Davis had not recognized the need to intervene, which Fletcher was basically begging that he do. He did not realize that if the matter were left to NASA there was no choice. Fletcher's words to Davis: "There was all this pressure to go for Solids while pressure-feds clearly held promise." Davis did not intervene, but instead asked Fletcher to resolve matters "in house".

The other major component of that Memorandum had to do, of course, with the presumption that NASA and the United States would have a Space program to go with the Shuttle.

Thereafter, success was nearly total. A desperate effort was mounted by OMB to "downsize" the Space Shuttle to less than what was required to carry the whole range of civilian and military payloads. To thwart that attempt, we literally "camped out" at NASA headquarters

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for fully ten days, day and night, working with our support teams in Princeton, El Segundo (Aerospace) and San Jose (Lockheed MSC), with the central point being that no costs were being "saved" with smaller configurations. Indeed, re-entry by a larger delta winged spacecraft was less problematical than with smaller craft, since the total mass was not that much reduced by downsizing, whereas the protective area slowing down the Shuttle during reentry indeed was reduced by such variations. We won that battle hands down.

The hearings in the Senate and House were equally extensive and, in the end, quite satisfying: the lead opponent of the Space Shuttle program was a Senator Mondale, who in the footsteps of Senator Proxmire tried to make a "name" for himself as a big aerospace program 'killer'. After everything was discussed, presented and reviewed, including "showdown" sessions with the proponents led by me and opponents led by Mondale, Proxmire turned to me and said, in front of Mondale: "I would like to compliment you for the work done and the thorough analyses. While I will not come out in favor of this vast program, I will certainly not oppose it." That meant the approval of the program. Numerous investigations and exams by GAO and others followed, including a Ph.D. thesis years later by Hum Mandel. It was shown that, despite serious delays in the procurement schedules, our estimates in 1971 of the costs of the RDT&E of the Shuttle program came within 5% (!) of actual costs as the program was realized.

But all was not well.

7. Price Controls, Inflation and the Shuttle development:

To finance the war in Vietnam, and because he was adverse to increasing taxes in an impending election year, President Nixon demonetized the dollar and imposed price controls. The logic was that with prices under "control" there could be no inflation. What resulted after 1972 was a period of the worst inflation ever experienced by the US in the 20th century. This significantly affected the Shuttle.

NASA had made a "pre"-inflation budget deal with OMB. NASA would develop the Shuttle as shown in the budget profiles, come what may. What did come was inflation, and OMB held NASA to the nominal numbers agreed to. The result was a disaster: programs were cut back, "non-destructive" testing was invented, and took over in place of reality

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simulations. Most importantly, at every juncture where NASA had the choice to do the more expensive but technologically advanced thing, NASA chose the cheap way out: on Solids vs. pressure-feds, on heat tiles vs. metallic/composite shielding on upper stages; whatever and wherever. The program was stretched, another "fund-raising" mechanism in government accounting and procurement.

8. Cancellation of the "European" Space Tug:

As we have seen, over 60% of all space missions are above and beyond LEO, the orbits reachable by the Shuttle alone. Implementing the vision and potential outlined for a reusable Space Transportation System required a reusable Stage – the Space Tug. But NASA had no such funding.

So the first approach was to talk the Europeans into joining us in the development of the STS, with the Europeans (ELDO, a predecessor of ESA) developing the Space Tug. I went on a crash program, and after a 12 month effort things had fallen into place: ELDO agreed to fund and build the Space Tug in co-operation with NASA. At the final presentation to a meeting of ministers in Brussels, however, I observed, when asked about the usefulness of the Space Tug and its technology (reusable, re-ignitable upper Ox/Hydrogen propulsion systems), that with 60% of all payloads needing such a stage and given the importance of these missions, the US government would do well to ask the Europeans not to proceed and to reserve the task of this development to the US. It took less than six months for NSA to be directed by the Space Interagency Group – that anonymous direktorat of un-elected officials of the space bureaucracy – to cancel any such agreement with ELDO/ESA.

Instead, the DoD initiated a "long march" to nowhere. It succeeded during the next decade to spend literally from $3 to 5 billion – some of it with and through NASA – with all programs failing either in infancy or resulting in technological still-births: the IUS (interim upper stage), the TOSS, the Centaur-in Shuttle, and then some. But in any case, the facts are that no such stage exists to date. This means that 60%-plus of all the potential missions just went "down the drain." Worse yet: the infrastructure to maintain the launch capability for these "out-of-reach" missions had to be kept in place, consistently with one of the key reasons

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for not pursuing a fully reusable upper stage to begin with (as they saw it). With it went a whole range of truly innovative new space applications, be they military, scientific or commercial. The negative impact of this single decision – and its consequences for the decades to follow – cannot be overstated. Few are aware of this even today.

9. Fatal Cutbacks – "Revenge" of the OMB Accountants:

With the advent of the Carter-Mondale presidency, the true disaster for the Space Shuttle program set in. With Mondale putting his "experts' into key "second" positions throughout the government – principally also the OMB – a veritable bloodbath set in for the Shuttle program. Mondale made sure he would be proven right as to the deficiencies of the Space Shuttle. The components of this demolition effort were varied and devastating:

9.1. Cutback of Shuttle launch sites from two (East and West Coast) to one (East Coast): these "savings" were arrived at by the logic that fewer launch sites would mean fewer costs. But this was wrong again: what it meant was that no polar launches could be made with the Shuttle, again leading to a further loss of applications and traffic. Of course, the Vehicle Assembly Building at Vandenberg had already been started and nearly a billion dollars invested in it. In addition, it also meant critical DoD "bureaucratic" support in annual budget battles. Somebody in SIG and the White House did not like the Shuttle.

9.2. Cutback of Shuttle Orbiters: the most devastating decision was to cut back the orbiter procurement from five to four (the original intent was actually to cut the fleet to three). This decision, combined with the closing of the western launches of the Shuttle – practically meant the end of the Space Shuttle long before its first launch. Not only were the missions for the Shuttle cut back substantially to a debilitatingly low level, negating most advantages, if any, of reusable systems – but by "freezing" the procurement, the technological evolution of the Shuttle beyond the initial compromises was foreclosed.

9.3. Disastrous budgetary implications. The end-result of this "policy" were substantially added expenditures, if only the additional $2 billion per year for maintaining the Titan launch infrastructure and capabilities, leaving aside for the moment the several billions already spent on the western test range to actually launch Shuttles from there.

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The US could have procured two Space Shuttles a year, and saved money, just by closing down the Titan.

As this "process" was taking shape, I repeatedly traveled to Washington, trying to prevent such a fatal decision. In early 1978, a confrontation (which I still have on tape, taken by Johan Benson of AIAA) took place in OMB, from which the outcome was an agreement that I could venture out to get private funding for a fifth Orbiter in return for being granted all the non-US government uses of the Shuttle. The next five years, I would pursue that prospect successfully in the market place, only to be turned down again by SIG after raising the requisite financing, not only for the fifth Orbiter, but also for the commercialization of the Titan launch vehicles. However, that is a separate story, except to the extent my basic goal of shaming the government into the procurement of additional orbiters is relevant. If nothing else, additional orbiters would provide for the event of catastrophic losses. It was all to no avail.

9.4. Lack of Space missions making use of Shuttle capabilities: once NASA had the task of developing the Shuttle (1972) and had become mired in an annual battles for the budget to support its development (e.g. in the crucial year 1978, where OMB and Vice President Mondale discovered the 'Shuttle Dividend' to balance the Federal Budget due to reduced Space Shuttle development costs), all other programs were subordinated or forgotten in favor of this single project.

While astronauts were completing the spectacular missions to the Moon – through Apollo 17 – launched a Space Station larger than the "current" ISS – called Skylab – and other remnants of the Space effort of the 1960s we were about to close down the opportunities for the 1980s and beyond. NASA was (deliberately?) unable even to allocate $100 million or so to boost Skylab to a higher orbit and so preserve our Space station capabilities into the 1980s – a failure of titanic proportions in its shortsightedness.

The "conjecture" by SIG was that, without a Space Station in orbit, the "next" program for the 1980s would be a Space Station for the 1990s, albeit both international and smaller than Skylab. This relieved NASA and SIG of thinking of truly new missions and applications, such as the ones outlined by us and based on the work of thousands of the

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best aerospace minds. Some of these included Large Geosynchronous Space Platforms, defenses against strategic missile attacks, Solar Power Satellites, large global climate and resources observation platforms, to mention but a few.

9.5. A Disaster that did NOT happen: the near failure of the First Shuttle (Columbia) Launch in 1981.

Disasters lead to great inquests, deep questions, self-doubt, sometimes a re-orientation of policies and programs either foreclosing or opening up entirely new "futures." One disaster that nearly happened was obvious for all to see, and involved the very first Space Shuttle launch. If one goes back and watches the video sequence of that take-off, one sees that something entirely unexpected happened: the shock-waves from the ignition of the Shuttle's main engines (a few seconds before the ignition of the Solids and take-off) traveled right back into the Shuttle structure, shaking the configuration and nearly breaking it up. What had happened was that the water stored below the take-off ramp to absorb the shockwaves from the ignition were scaled based on the Apollo experience in which all engines of the first stage ignited simultaneously, rather than sequentially. Nobody had anticipated these "second order" effects that would occur on the launch pad while waiting for the Solids to ignite.

If the Space Shuttle had broken apart right there on the ramp on its maiden flight, for all to see in one of the most spectacular "fireworks" ever ignited, with total crew loss and who knows what else (e.g., if some of the components had spun out of control toward the viewing stands), it would have been the end of the Space Shuttle program.

But by some fluke of nonlinear dynamics or "robustness" of the system, this did not happen. But because of that, was the Space Shuttle less risky? And in reverse: had that accident happened, would the Space Shuttle program and manned space flight have been less worth pursuing? Most certainly not, at least in my opinion, yet such accidents and non-accidents overridingly shape the "direction" of the US Space program.

10. Attempt to Salvage Fatal Cutbacks in the Shuttle Program: Private Funding for Orbiter V.

10.1. Round I of the private funding for Orbiter V (the Carter

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Years)

Freshly armed with the "mandate" to arrange private funding for Orbiter V – obviously with OMB convinced no such effort would succeed – I arranged an aerospace consortium around Boeing as the main (or lead) investor. I chose Boeing for the pursuit of this first attempted financing because Boeing had been "left out" of the space side of the aerospace business: having done the Saturn II stage in the Apollo program and with significant involvement in the Skylab program, Boeing had gone empty on all major Space Shuttle components. So there was a desire to get "back in." Boeing's capital and sales base, when compared to that of the rest of aerospace industry, was firmly grounded by then in commercial markets. In addition, Boeing had the largest operating experience and data base on aircraft operations, which might be applicable to Space Shuttle operations as well.

Such a consortium did form around a Space Transportation Company concept not dissimilar to the Comsat model established in the 1960s for Civilian Space Communications. It included Boeing in a lead role, Martin-Marietta, United Technologies, Thiokol, North American Rockwell and some other companies.

But just as the venture was about to take off, "infighting" broke out within the consortium, each one trying to grab a larger share of the pie. In the end, what it really came down to was the statement by the Space Shuttle contractors that Boeing had little, if anything, to contribute, forgetting that none of the other companies had the capital base or the operations experience of the Boeing company. For that matter, none of them had the gumption actually to go out into the marketplace and risk their own funds in pursuit of larger future rewards: they were much better off living off the government dole, with contracts locked up for decades to come "as long as nobody upset the apple cart".

10.2. A Trip to Paris and the Founding of Arianne Space:

After I raised the prospect of private funding of the fifth Orbiter and the formation of a Space Transportation company to see to the marketing of this capacity, French aerospace and government officials invited me and an official from Boeing (Gil Keyes) to join for a one-week meeting in the French Senate to explore what Europe should do in operating the Arianne launcher program. Our proposal was simple:

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form a company under private corporate law; involve banks, financial institutions, aerospace companies and government institutions; and retain government oversight functions via the Board. This was basically the Comsat example set under President Kennedy for space communications in the early 1960s. Any other approach was not likely to succeed in the marketplace.

The French and Europeans formed what today is known as "Arianne-Space" within six months of that meeting. Arianne Space is today the most successful Space launch company in the world.

10.3. Reorganizing under Reagan:

On February 29, 1980, some of us from High Frontier met with Mr. Ronald Reagan in the "wilds" of New Hampshire and briefed him on the prospects of, and need for, ballistic missile defenses. At lunch, Reagan said that if he became President he would initiate such a program. [That very afternoon the "incident" with George Bush Sr. occurred concerning the number of participants in the evening's discussion: Bush wanting a one-on-one with Reagan, to the exclusion of all others. Reagan thought that unfair and settled the issue with: "I paid for this event and I have decided that all shall be given a chance to participate" (or words to that effect). The effect was so striking that it ended the primaries and the rest is history.]

I also came away more determined than ever to save the Space Shuttle program set for it when Mondale ruled on Space matters. I had come to the conclusion that an aerospace consortium was not likely to succeed for the reasons stated above. Given the strong and positive case for a fifth Orbiter, I decided to approach it via a purely financial route, with aerospace becoming contractors, a role they had become accustomed to.

To such purpose, I incorporated the Space Transportation Corporation and brought a group of investment bankers into the venture, former partners of Morgan Stanley, White Weld and Co., Eastman Dillon, and various legal and accounting talents. After the business analyses were completed and a framework of understanding worked out with competent NASA officials, Prudential came on board, with a commitment to invest every year about $6 billion, or $30 million every business day. The case for the Shuttle, subject to reaching agreement

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with NASA, was ironclad. Prudential had an additional motivation: being the largest insurance company, invariably Prudential was also the premier financing entity for all commercial Space ventures, principally communications satellites. What good were these "investments" if they could not be launched to orbit?

This led to an additional "complementary" investment: commercial launch back-up with expendable rockets. In light of a survey of available options, and of the need to back up all Space Shuttle payloads that might develop in the future, there was only one system that would fulfill such requirements: the Titan family of launch vehicles. After intense negotiations, we signed an exclusive worldwide agreement with Martin Marietta on October 29 at Cape Canaveral in Florida. The signing corresponded with the first launch of the Titan 34 D, later christened the Titan III.

In 1982, Federal Express joined the SpaceTran venture and President Reagan formed the Space Commercialization task force. The road to substantial private funding and involvement in US space transportation seemed open and imminent. At the UNISPACE meetings in Vienna, Austria, in the Summer of 1982, we celebrated the agreements in principle. The then NASA administrator Jim Beggs seemed ecstatic.

However, we had not checked with the "hidden" government structure, the Space Interagency Group, a group determined to "save" the United States and mankind from any such undertaking. The obstacles to such enterprise were this time not buried in the Department of Defense, the usual villain to the academic community of "experts" and "cognoscenti," but in the civilian side of the Space government community.

Worse yet, whereas the President and the White House clearly were on our side and the side of more commercial involvement, it was this civilian government core of bureaucrats who saw their "well earned" spot in the sun of government power being whittled away just at the point of "fruition". Here some examples:

10.4. On Expendable ("Rocket") Space Transportation: Instead of following the Comsat example on how to organize US space activities in areas of commercial potential and of national security concerns (and Intelsat for international uses) or of following the example just set by

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Arianne Space (a combination of financial, industry and government investments), the USG set out to splinter US space activities. It invented yet another bureaucracy at the US Department of Transportation, which swiftly set out to foster all US expendable rockets aerospace companies and systems and incentivise – in a rush of hubris – even new ones, all of which subsequently failed or cost the sponsoring companies untold billions in unrecovered costs, or additional costs to government contracts. Of course, Space Shuttle operations and marketing were to stay a monopoly of the US Government, in this case NASA.

However, when a private group – SpaceTran – was poised to win (in international competition against Arianne Space and against US subsidized government Space Shuttle launchers) the $1 Billion Intelsat VI contract for launchers, fully coordinated with and approved by the US Air force and Department of Defense, this same SIG and NASA intervened to disallow the use of launch pad 39 B already agreed to by the Air force. This abrogated SpaceTran's competitive bid, which was subsequently won by Arianne Space. The SIG and NASA attitude: better a bunch of foreigners than letting loose US private space enterprise. After meeting with Hans Mark (then the Deputy Administrator of NASA and the chief SIG honcho) on these issues in the spring of 1983, Fred Smith (Chairman and CEO of Federal Express) turned to me while outside the still open-door and in a loud voice commented to me: "Klaus, this was the first time in my life that somebody lied to me, realized that I knew he was lying to me and then continued lying to me!"

10.5. On Privatizing or Commercializing Remote Sensing: Again, rather than follow the Comsat precedent set in the 1960s and despite the explicit desire and intent of President Reagan, SIG set out to sabotage the privatization of remote sensing, be it of land and ocean resources or of weather satellites. The very day in the spring of 1984 that President Reagan announced his desire to commercialize and privatize these government activities, all the major media (newspapers and special television reports) had lead articles on how stupid any such endeavor was judged to be by worldwide comments and reactions well-orchestrated by SIG and their ideological co-brethren. How could it be that even before the President had announced his policy, the US and world reaction was negative to any such restructuring of USG monopo-

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lies?

Yet worse was to come. Some of us in industry had organized an international consortium to do exactly what President Reagan advocated – commercial remote sensing using the Space Shuttle and combining Comsat, private US investors and international aerospace firms. In response to this, in a panic of regulatory overreach the SIG imposed what euphemistically was titled the Landsat Commercialization Act of 1984. Title 4 of that act outlaws all private ownership of original space data (!). It did this despite the fact that we had already a signed contract with NASA, the terms of which were that under specific and explicit standard agreement all those data indeed were to be our private property. SIG had to revert to such constitutionally suspect brutality, since otherwise they had no "handle" on our making untold millions from applications and technology which SIG was negligent of having thought about or implementing. (In a meeting with us in the Roosevelt Room of the White House in 1984, it dawned on SIG that they had totally missed the fact that we did not need US Government frequency approvals, since we had put all the data on other media. This meant SIG could not dictate to us "fair pricing" policies that would be set to ruin any attempted private activity.)

The fact that the same legislation also outlawed the operation of all television cameras in and from space in clear violation of first amendment rights was of little, if any, concern to this policy group.

Now, twenty years later, the same space bureaucracy finally has come around to conclude that indeed it is advantageous and efficient for the US Government to avail itself of commercial, private remote sensing capabilities. How much further could we have advanced by now, at what untold savings to the US Government: NIMA and its predecessors in the 1980s would have saved up to $1 billion in multispectral and panchromatic imaging and map-making alone if they had allowed the Stereo MOMS venture to proceed in 1984.

10.6. Turning Down Private Funding for the Space Shuttle: Instead of jumping at the opportunity to provide a "zero Government cost" back-up and the continuation of Shuttle production capabilities, NASA did everything imaginable to sabotage the venture. First, it did not believe that such a venture could be funded on the merits. Then – with

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Prudential Insurance and Federal Express joining SpaceTran – NASA went to infinite lengths to "study" the economics of the venture (for what purpose is unknown), while all along we were not asking for any government guaranties except an assurance of six launches a year from the fleet of Shuttles, with all incremental costs reimbursed to NASA. After years of negotiations and deliberations, NASA turned down our proposal for funding the fifth Orbiter (at a negotiated price from Rockwell of about $1 billion). NASA alleged we would be making too much money and not taking enough risk – like losing an orbiter: that was the NASA testimony in March 1986 after the Challenger explosion. Orbiter V would have been rolled out in July 1986. Instead the US did not launch any spacecraft for over two years, and the fifth Orbiter cost US taxpayers about $3 billion.

11. The 1992 Columbus 500 Space Sail Competition:

Having thus far failed to bring about substantial private and commercial involvement in the US Space program, I made a final attempt to bring about such independent and market-based involvement of non-USG people. The Columbus 500 Space Sail Cup was conceived by me and the Hon. James Symington, former Chairman of the House Space and Sciences committee in the 1970s. Needless to say, despite overwhelming US participation and proposals, NASA could not be moved to support any such effort. As a result the only group actually launching such a sail was a Russian team led by the very same Vladimir Syromiatnikov of Apollo Soyuz fame: on February 4, 1995, the first Space Sail set out and stayed in orbit for several days, substantially longer than a similar first, the flight of the Wright brothers nearly 100 years before.

12. Many other examples and many other ventures and enterprises could be added to this "honor roll" of ill-conceived, self-serving, if not mean-spirited, policy decisions of SIG in their pursuit of preserving the USG monopoly on space and access to space: The SIG would consistently support any venture that was likely to fail. Any venture likely to succeed outside the boundaries of absolute and total USG control, they would set out to sabotage and to prevent, if necessary by ex-post-facto legislation.

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III: Failures / Omissions in Columbia Disaster

Obviously the Commission investigating the Columbia disaster has a detailed list of issues and questions about the causes that led to Columbia's fateful last flight and loss of life. I am not privy to those discussions, so it may be that the following issues that are raised in my mind may be extensively covered. But with what has become public so far I am disturbed by the following broader issues:

13. Lack of In-Orbit Rescue and standby capability:

The media and the Commission go to great lengths about why NASA did not request NRO/NIMA to use its capabilities to give an assessment of the state of Columbia after its fatal launch. At the same time, a question that is not asked is: What could NASA have done about it, whatever these images might have shown? The obvious answer is that it could have done nothing. NASA refused to and/or was directed by "statute" not to avail itself of rescue capabilities. These were to be found in the extensive docking, re-supply, rescue and standby capabilities developed by and with Russia over decades past, such as under the Apollo-Soyuz program, the Shuttle-Soyuz program, the Shuttle-MIR Space Station program and the ISS-Soyuz capabilities.

I was utterly dismayed when NASA agreed – without protest, resignation or other act of protest – to the statutory prohibition of availing itself of "non-US" capabilities for the ISS (and apparently also for the other components of the STS infrastructure), just to come up with a "rationale" for a multibillion dollar Crew Emergency Rescue Vehicle (CERV) capability. A cost-efficient CERV capability exists – and has now been demonstrated by the Proton-Soyuz rescue and support for the ISS crew, including my friend Don Pettit.

Why has NASA advocated/gone along with the "statutory" prohibition of "non-US" capabilities, which have proven and now continue to prove efficient, reliable and very, very cost-effective? Why has it preferred to develop – with meager resources – new space transportation capabilities that have been so utterly needed and so totally neglected by NASA over at least the past 25 years (see section II below)?

Clearly, some emergency was foreseeable and, equally clearly, an easy, reliable rescue capability existed and could/should have been

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procured and deployed. But it was not. The reason is the rank incompetence of what obviously is the deliberate process of the Space Interagency Group – in the name of a totally misunderstood "national security" strategy aimed at a US monopoly and at the destruction of competition from any private, international, or other agencies unless they are "privileged" or anointed.

What could have been one of the great rescue missions of seven Shuttle astronauts by a Russian emergency launch and the rescue of "our" astronauts – equal in excitement and goodwill as the splendid Apollo 13 mission – instead saw the helpless burn-up of the Columbia crew under a veil of ignorance. Such a Soyuz rescue capability in standby mode at Cape Canaveral and/or at Russian / Kazakh facilities (depending on the orbit of the specific Shuttle Mission) should have been a standard requirement rather than an afterthought, particularly when we consider that all the requisite docking technology was developed and tested at great expense – and can be seen in the Air and Space Museum in Washington DC in the main entrance hall.

More to the point: was the ignorance "willful"? It would make no sense to ask top management to request outside agencies to obtain data and information that would only add to the tragedy – indeed, that would expose the endangerment of true national security that stems from the "statutory" prohibition against providing efficiently for the security of the Shuttle and Space Station flight crews. After all, in this age of accountants, why "waste" precious resources for data and information that, if confirmed, would not allow any action whatsoever to "save" the astronauts, indeed would only prolong and dramatize the agony globally and "live," in real time?

It is then a very lame statement to say to the US public and the media "that no statute was/is being violated by the Soyuz rescue of the current ISS crew, as no US funds will be expended in that rescue."

A less cryptic statement might have been:

"Because of the special interest legislation mandating NASA to duplicate existing capabilities for providing for the re-supply and rescue of ISS and Shuttle crews in orbit and prohibiting US Government expenditures for providing for such outside rescue by NASA, the lives of seven astronauts were in all likelihood lost. Furthermore, NASA is now

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greatly indebted to the extraordinary offer by the Russians to come to the aid of the ISS and its crew at their expense, as current US statutes prohibit NASA from even contracting for such emergency rescue missions."

14. The Columbia's Age as a Contributing Cause of the Disaster:

The statement immediately after the Columbia disaster to the effect that Columbia had flown only a few hundred hours whereas civilian and military aircraft fly tens of thousands of hours and that therefore the "age" of Columbia by implication had nothing to do with the disaster is one of the more unfortunate statements after the disaster – and a disaster all by itself.

This statement may have been drafted by "communications" specialists trying to absolve with pre-emptive spin even the appearance of possible NASA management flaws in the operations and procurement philosophy of the Space Shuttle program. Be this as it may, the statement is obviously devoid of any aeronautical understanding of the totally different aerodynamic environment of space flight as against experiences "enjoyed" by Bonus Mileage veterans of civil aviation flight. Even the most basic knowledge of rocket launch environmental stresses (acoustic, mechanical, etc.) should have prevented the use of such a statement. But since it was made, it glaringly highlights a lack of the understanding or seriousness that the topic at hand – manned space flight and safety – should demand. But then NASA has been in denial of such issues since soon after the inception of the STS program was initiated in 1972 (see Part II above).

The potential loss of orbiters was a fundamental part of the initial assessment and procurement philosophy of the Space Shuttle program. This was disastrously abandoned in the late 1970s and left uncorrected after the Challenger disaster. One principle of the original policy was to recognize material fatigue. Additional factors included technical obsolescence, the need to replace "improvisations" such as thermal tiles, solid rocket assists, avionics, other materials and consideration of the results of actual flight experience. These all fed into the continuing procurement of orbiters, with an initial batch of five to be followed by one new orbiter every year or two, depending upon actual flight levels and experience. This philosophy was deliberately abandoned due to

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budgetary and "institutional" reasons by the end of the 1970s.

In 1971, we estimated the loss rate of orbiters to be around two in 100 flights, a number frighteningly close to the actual experience. This risk cannot be reduced by the fleet of 1960s-generation orbiters, whatever the U.S. spends.

The risk factors were not improved by the "discovery" in the 1970s – not least for budgetary reasons – of the new panacea of "non-destructive testing", as if simulations and computer runs ever could be a substitute for testing and measurements until actual failure such as, sadly, the one now experienced again with a live crew.

Rather a continuity of orbiter procurement and upgrading was needed throughout these decades and in decades to come, with recurring losses from time to time – if one were serious about the future of manned space flight (Chapter IV below). Historically, the "recurring losses" in missions of exploration in past centuries were well in excess of 50% (only a few dozen of the 100+ Chinese ships returned in 1423 from their worldwide expeditions; and only one in ten trading missions to the East paid off for Spain, Portugal and later England. Nevertheless, the "West" persisted in manned exploration, to the benefit of all of us here today in the Americas.)

Columbia failed in part – or possibly mainly – because it was the oldest, overstressed ship with unpredictable ("non-linear") material and other failure modes.

But we must not let these immediate issues and causes for this recent disaster obscure the 30-year road to disaster due to fundamental program management issues and false "compromises".

IV: Where Do We Go from Here?

Looking now at the shambles and ruins of 30 years of ill-begotten SIG policy and NASA "management" of space transportation and the US space program, where should we go from here?

15. NASA's "New" Strategic Plan: Abandoning Manned Space Flight?

NASA's "new" strategic plan for the decade(s) to come was revealed in the briefing by the NASA Administrator O'Keefe on Thursday, April 17, 2003. In this plan, NASA 'courageously' proposes to

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terminate the Space Shuttle program (over 12 to 15 years) and to substitute a multibillion dollar "aerospace" plane which is nothing but a reusable astronaut rescue capsule launched on an expendable rocket. This was a "vision" soundly rejected in the early 1970s. The plan also calls for a termination of any manned space exploration.

The vague hint at possible human support functions for establishing robot structures at L1 (or L2, L5, or wherever) is not even a fig leaf covering the absence of any intent to see a United States presence in the manned exploration of the Moon, the solar system, or the stars. Yet this "sinking of the US space fleet" was couched in language that to the unsuspecting listener might actually sound as if our quest were to continue: not a single headline in the media appeared highlighting this historical abdication by this NASA and this president. At least the Chinese accountants running government affairs in 1423 knew what they were doing, and that they were doing so at the express orders of the successor to Zsu Di.

16. A Program worthy of the United States, at little (if any) extra cost:

16.1. The First Step on the road to reclaiming leadership in space is to set a firm, overriding goal for Manned Space Exploration, namely the establishment of a Permanently Manned Lunar Base that will test the full range of Closed Ecological Life Support Systems (CELSS), leading ultimately to the capability of totally autonomous, earth-independent homesteads for mankind in space.

This can all be accomplished efficiently and safely on the Moon, without need to proceed further at immense costs, risks and potential loss of life. Any discussions of "plans" or "programs" or "missions" beyond such a Lunar Base are smokescreens to deflect from a viable manned Space program. One has to learn how to take these first steps before setting out on unrealistic, possibly fatal, interplanetary missions. Once this has been set as the driving goal, the other decisions follow logically:

16.2. The Second Step: Upgrade Space Shuttle to 2000 Technology.

The technology upgrades and choices are clear: the SSMEs (Space Shuttle Main Engines) work great – the major accomplishment of the

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initial Shuttle RDT&E. What need upgrading are:

16.2.1. Thermal protection technology: replace the "tiles" approach with new metallic/composites suitable for routine reuse;

16.2.2. Thrust assist – replace the solids with pressure-feds/liquids, allowing intact abort, cross-feeding, redundancy, and substantially lower transportation costs;

16.2.3. Continuous procurement of new Orbiters, allowing thereby the upgrade of US low earth orbit space transportation capabilities;

16.2.4. Evolution toward fully reusable Space Shuttle Technology: as technology and operational experience evolve, a gradual movement toward a fully reusable Shuttle is possible.

16.2.5. In-Orbit Crew Rescue Capability: this capability already exists with the Soyuz-Shuttle docking capability demonstrated in the 1980s. All that needs to be done is to implement it operationally, at little cost.

16.3. A Reusable Upper Stage (Space Tug): already a central piece of the 1972 Space Tranportation System decision, this key technology should now be implemented, including a capability for Lunar Orbit, Landing and Return missions.

16.4. Significant New Space Science and Application Mission Platforms: some of these missions have been outlined in the "new" NASA strategic plan, but key applications technology initiatives are missing, first and foremost in the information-technology areas. Large geo-synchronous platforms – and beyond – building on our space infrastructure should be a principal component, both in applications and in the sciences.

17. These goals can be achieved over the next decade and form a real basis for future US manned missions throughout the Solar system.

Most importantly, the United States will set the historic precedent of a homestead outside earth. That homestead will ultimately be able to function without any support or input from earth – a true "Independence Base" – crucial for the survival and expansion of mankind throughout our solar system and ultimately beyond.

Everything else should be secondary to the space program, NASA, science and technology. Aeronautics, astronautics, life sciences, astronomy and many of the other areas of innovation, important as they are, should be funded at substantially lower levels than they now succeed

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in obtaining as a "fair share" of the space program, while other activities of human exploration might substantially increase.

The rationale – the raison d'être – of NASA is Manned Space Exploration. NASA seems to have forgotten this and – at least for the past three decades – is meandering around, not knowing what to do and where to go.

Let us not "burn" our space ships so that others one day will look back in wonderment on how and why the United States failed at this historic moment.

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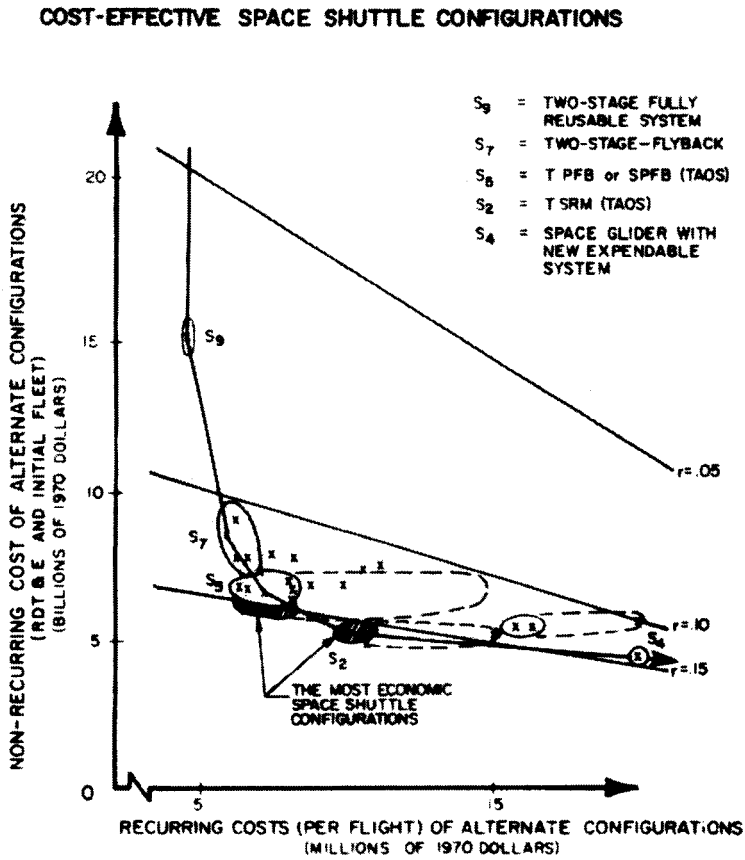
Figure 1:
The 1971 Space Shuttle Decision –
Selecting the Thrust Assisted Orbiter Shuttle (TAOS)



Economic Trade-off Function for Space Shuttle System when Social Rate of Discount is Varied from 10% to 5% and 15% (514 Shuttle Flight Space Program)

Figure 0.10

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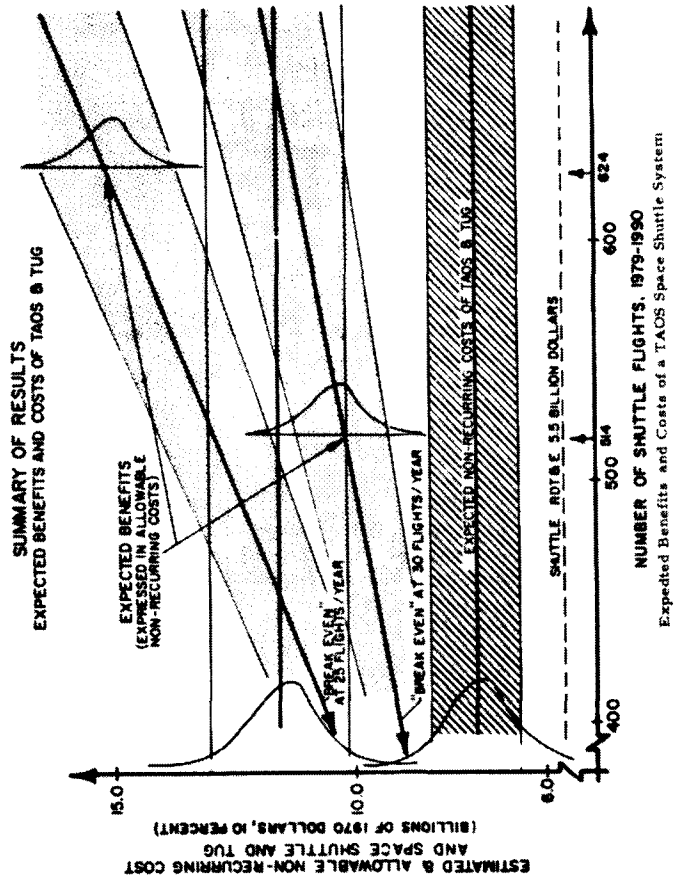
Figure 2:
Space Shuttle Flights and 'Breakeven':
With and Without Advanced Space Applications



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Proliferation of Weapons of Mass Destruction: Iraq and Iran

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For most of the 1990s and the early 2000s the international community was concerned about finding and destroying Iraq's weapons of mass destruction (WMD). Following the toppling of Saddam Hussein's regime in 2003 the focus has shifted to the neighboring Iran. This essay examines the acquisition of chemical, biological, and nuclear weapons and the missiles that deliver them in both countries. It discusses each country's motives for seeking such capabilities and attempts a history of their arsenals. Finally, the paper analyzes American efforts to prevent, or at least slow, the proliferation of WMD in Iran in the aftermath of the 2003 war.

Key Words: Iraq, Iran, WMD, Gulf oil, Gulf War, Iran/Iraq war.

Since the early 1980s the Middle Eastern military and strategic environment has been in a state of flux. The Iran-Iraq war (1980-88), the Gulf war (1991), and the war in Iraq (2003) have drastically altered the strategic dynamics of the region. Three developments, with significant strategic implications, can be identified. First, Iran's conventional military capabilities under the Islamic regime have been severely restrained. The massive destruction of a large proportion of Iranian arms during the war with Iraq combined with a relative lack of available funds to buy new weapons suggest that militarily Tehran is much weaker than it was under the Shah. No more does Iran have the capability, resources, or international backing to play the role of the policeman of the Gulf, which it played in the 1970s.

Second, far worse than Iran, Iraqi military forces have been substantially destroyed. Enjoying high oil prices and revenues, Baghdad was a leading military force in the Middle East in the late 1970s. The three Gulf wars dealt a heavy blow to the Iraqi military capability and as a result of the last conflict Saddam Hussein's regime was toppled and a "new Iraq" has been established. The post-Hussein Iraq will re-define its national interests and its regional and international relations.

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Third, subject to this changing military calculus and the subsequent strategic uncertainty, it is worth noting that weapons of mass destruction (WMD) – chemical, biological, and nuclear weapons, and the necessary missiles to deliver them – have in the past been introduced and used in the Gulf region. Chemical weapons played a decisive role in the Iraqi attacks on the Iranian troops from 1984 until the end of the war in 1989. In response, Tehran sought to retaliate in kind to the Iraqi attacks and developed its own stockpile of chemical weapons. Furthermore, the two countries launched massive missile attacks against each other's cities.

For years prior to the 2003 Iraq war, both Iran and Iraq have been interested in developing such capability not only to match Israeli power, but possibly more importantly to gain military and strategic leverage in their disputes with each other. Regional rivalries and insecurities compel nation-states to undertake efforts to safeguard their core interests. The acquisition of WMD and secure delivery systems would appear logical and even necessary to achieve this goal. Prestige can be seen as another incentive for states to acquire WMD, particularly nuclear capability. Nevertheless, the stockpiling of these non-conventional weapons combined with political rhetoric can substantially increase the odds for catastrophic war in the Middle East, and increase the chance for pre-emptive and preventive strikes.

This essay will review the status of WMD in Iraq and Iran. Particular attention will be given to the motives and history of the efforts to acquire these non-conventional capacities. Furthermore an assessment of the chemical, biological, nuclear, and missile capabilities of each state will be provided as well as their stand on the international non-proliferation norms and agreements. Finally, the future of WMD in the Middle East will be examined.

Iraq

During the Saddam era, Iraq was an interesting and unique case in the area of proliferation of weapons of mass destruction (WMD). From the early 1970s the Iraqi experience with WMD featured the following characteristics. First, unlike many other developing countries, Baghdad had the necessary ingredients to manufacture and develop robust non-conventional capabilities. These included massive financial resources

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due to the skyrocketing in oil prices and revenues, a progressive technical infrastructure managed by thousands of competent engineers and scientists, relatively good relations with the major global powers (until the invasion of Kuwait), which enabled Baghdad to receive technical assistance from France and other European countries in the 1970s and some degree of tolerance by the United States to its stockpiling and use of CW in the 1980s. Interestingly, the Security Council of the United Nations issued a resolution, endorsed by the United States, condemning the Israeli attack on Iraq's nuclear facilities in 1981. It is little wonder that by the time of the Gulf War (1991) Iraq had assembled an impressive stockpile of WMD, and was very close to manufacturing nuclear devices.

Second, Iraq was not the only country in the Middle East to seek non-conventional capabilities. Many of its neighbors such as Iran, Syria, Israel, and Egypt, are believed to have different kinds of WMD. Also, Iraq has not been the only Middle Eastern state to use CW. Egypt used them its war in Yemen in the early1960s and Libya used them in the war in Chad several years later. What was different about Iraq is that it used CW extensively on both its enemies (the Iranians) and its own population (the Kurds). Saddam Hussein's regime's use of CW is probably more documented than any other CW use since the First World War.

Third, Iraq is the first and only country in the world to experience a pre-emptive strike on its nuclear reactor (the Israeli raid on Osiraq in 1981). Furthermore, the U.S.-led attack on Iraq in March 2003 was justified, at least partly, by the allegations that Saddam Hussein possessed WMD and refused to destroy them. (As discussed below, these allegations were proven questionable). Thus, in the course of two decades Iraq had been subjected to two pre-emptive attacks, one by Israel and the other by the United States, to rid the country of WMD.

Fourth, more than any country in the world, the Iraqi program to acquire and develop non-conventional capabilities was put under strict United Nations scrutiny for most of the 1990s and the early 2000s. Following the Gulf War, two commissions – the United Nations Special Commission (UNSCOM), and the United Nations Monitoring, Verification, and Inspection Commission (UNMOVIC) – were created to find and destroy Iraq's WMD. It is still not clear if these two

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commissions had completely eliminated all of Iraq's WMD, but they did find and destroy many of Iraq's non-conventional capabilities.

Taking into consideration these characteristics of Iraq's experience with WMD, the analysis here will proceed to examine Baghdad's motives in acquiring and developing such capabilities, and how and when Iraq started building them. This section provides an assessment of Iraq's WMD before the 2003 war. Understanding Iraq's motives to acquire non-conventional capability sheds light on the question of WMD in the post-Saddam Iraq.

Iraq's efforts to acquire WMD started in the early 1970s and intensified during the war with Iran in the 1980s. This move to build non-conventional capability was driven by at least three reasons. First, the Ba'ath party came to power in 1968, after which Saddam Hussein concentrated all power in his own hands. Saddam had an ambition for himself and his country to lead the Arab world. President Nasser's demise in 1970 left a leadership vacuum in the region. Egypt was growing poorer and weaker and President Sadat needed time to establish himself as a statesman. Furthermore, Sadat's strategy to make a unilateral peace with Israel further isolated Egypt. Meanwhile, Iraq was a solid candidate to replace Egypt and lead the Middle East. Saddam was able to crush the Kurdish rebellion after signing a treaty with the Shah of Iran, under which the latter agreed to cease all assistance to the Iraqi Kurds. At the same time, Baghdad enjoyed unprecedented economic prosperity due to skyrocketing oil revenues. By utilizing these financial resources to build Iraq's conventional and non-conventional military power, Saddam Hussein came close to fulfilling his personal ambition to project himself and his country as the absolute leader of the Arab world.

Second, despite the fact that Iraq does not share borders with Israel, the two countries have seen each other as sworn enemies. Since Israel was created in 1948, the Iraqis have claimed a leading role in the Arab-Israeli conflict. By the early 1970s Israel was believed to have developed its own nuclear devices. The Arabs' failure to match Israel's nuclear capability created and deepened a sense of humiliation among many Arabs. Building an "Arab bomb" and ending Israel's nuclear monopoly in the Middle East would have restored a sense of pride for many Arabs.

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The Israeli attack on the Iraqi nuclear reactor in 1981 and the Israeli Prime Minister Begin's declaration that Jerusalem would prevent its adversaries from developing nuclear weapons further strengthened Saddam Hussein's determination to pursue a nuclear option. In other words, Iraq's efforts to develop WMD was motivated to a great extent by Baghdad's perception of the Israeli threat to its own national security as well as the overall imbalance in nuclear capability between Israel and the Arab world. The Iraqi leadership wanted to remove this imbalance and to close the technological gap between the two sides.[2]

Finally, the most important reason behind Iraq's drive to acquire and develop WMD was the deep-rooted hostility and distrust toward Iran, which is bigger and more populated. The two countries have had territorial disputes over the division of Shatt al-Arab since the 1930s. When the British withdrew from the Persian Gulf region in 1971, Iran invaded and occupied two strategic islands at the mouth of the Gulf, the Greater and Lesser Tunbs, and expanded its control over a third one, Abu Mussa. The Iranian occupation was perceived in Baghdad as a major threat to Iraq's access to the oceans. Furthermore, Iran under the Shah was establishing and expanding its nuclear program. Saddam and his strategic planners probably suspected that Iran had nuclear ambitions.[3] Under these circumstances, WMD could apparently serve as a deterrent and an equalizer. The Iraqi's extensive use of WMD during the Iran-Iraq war played a crucial role in de-moralizing the Iranian troops and proved the military and psychological impact of these weapon-systems.

Baghdad's interest in non-conventional capabilities started as early as 1959, one year after the monarchy was overthrown, when it established an Atomic Energy Commission and contracted for a research reactor from the former Soviet Union. The reactor was completed in 1968. The Soviet Union, however, was slow providing the nuclear assistance Iraq demanded and the Iraqi leaders were not completely satisfied with the Soviet technology. Accordingly, Iraq turned to other

[2] Gawdat Bahgat, "An Overview of Gulf Security: Oil and Weapons of Mass Destruction," *Disarmament Diplomacy*, No.33, December 1998/January 1999, pp.6-11, p.9.

[3] Amatzia Baram, "An Analysis of Iraqi WMD Strategy," *Nonproliferation Review*, Vol.8, No.2, Summer 2001, pp.25-39, p.27.

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sources. In 1976, Iraq bought from France a 40-megawatt materials test reactor called the Tammuz-1, or Osiraq, that ran on weapons-grade uranium fuel. In 1979, Iraq established a radiochemical laboratory, equipped through a contract with an Italian company suitable for laboratory research on reprocessing. It also acquired a fuel fabrication plant from Italy that was suitable for making natural uranium targets for secret irradiation in the Osiraq reactor.[4] Iraq also bought uranium from Brazil, Portugal and Niger.

The Israeli preemptive strike on Osiraq in June 1981 ended the first stage of the Iraqi nuclear program. The Iraqi leadership, however, was determined to challenge the Israeli nuclear monopoly in the Middle East and to revive and rebuild its nuclear program. The war with Iran in the 1980s helped Iraq initiate and expand efforts to build non-conventional capabilities. Baghdad skillfully played on the fear in the West and the Persian Gulf of Iranian fundamentalism, and presented its secular regime as a bulwark against radical Islam. As a result, many Western governments and companies either directly sold Iraq conventional and non-conventional weaponry or looked the other way. Under these favorable conditions, Iraq intensified its use of CW against the Iranian troops. Iran initially lacked the capability to retaliate. Indeed, during all the eight-year war, Iran's chemical and missile capabilities were no match for Iraq's. Iran's inability to respond in kind to Iraq's WMD attacks prompted Saddam Hussein further to escalate Iraq's use of these weapons. In contrast, Saddam Hussein opted not to use chemical or biological weapons against the Allied troops or Israel during the Gulf War (1991) because of fear of in-kind – or worse, nuclear – retaliation.

In addition to the massive build-up of Iraq's chemical, biological, and missile capabilities in the 1980s, Baghdad invested substantial resources in reviving its nuclear program. It is unknown how advanced the Iraqi nuclear program was, but the consensus is that on the eve of the Gulf War in 1991 Iraq was very close to possessing a nuclear explosive. Confident of his expanding WMD arsenal, Saddam Hussein

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[4] David Albright and Khidhir Hamza, "Iraq's Reconstitution of Its Nuclear Weapons Program," *Arms Control Today*, Vol.28, No.7, October 1998, pp.9-15, p.10.

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started making threats to Israel. In a famous speech in April 1990, the Iraqi president vowed to burn half of Israel if it attacked Iraq. Furthermore, he promised to retaliate against Israel if it attacked any Arab country. In other words, the possession of WMD provided Saddam Hussein with the means to claim a leadership position in the Arab world. These threats, however, proved premature. As one analyst put it, "Threatening a power that Saddam believed to have nuclear weapons, before he himself acquired a similar capability, represented a leap of faith. [by Saddam]"[5]

Iraq's growing WMD arsenal represented a major challenge to Israel and other regional and international powers. Indeed, the destruction of Iraq's WMD infrastructure was high on the coalition's motives for going to war with Iraq following the latter's invasion and annexation of Kuwait in August in 1990. A pre-emptive attack on Iraq nuclear facilities similar to the Israeli raid in 1981 was not an option. Baghdad had learned how to hide and protect its nuclear reactors. The Osiraq attack was a one-time affair against a positively identified target.[6] Instead, following the Gulf War, the Security Council of the United Nations issued resolution 687, which mandated that Iraq eliminate all of its biological, chemical, and nuclear weapons programs as well as all of its ballistic missiles capable of traveling more than 150 kilometers. The resolution required that the United Nations establish a special commission, UNSCOM, to verify that Iraq's biological, chemical, and proscribed missile programs were eliminated, and the International Atomic Energy Agency (IAEA) was charged with doing the same for Iraq's nuclear weapons program.

These two organizations started immediately their search for Iraq's WMD. Despite enormous obstacles, they found and destroyed tons of these weapons, prohibited missiles and the main infrastructure to manufacture them. A turning point in UNSCOM's operations came in August 1995 after the defection of Lt. Gen. Hussein Kamel, Saddam Hussein's cousin and son-in-law, who directed Iraq's illicit weapons

[5] Amatzia Baram, "An Analysis of Iraqi WMD Strategy," *Nonproliferation Review*, Vol.8, No.2, Summer 2001, pp.25-39, p.37.

[6] Ahmed Hashim, "Iraq: Profile of a Nuclear Addict," *The Brown Journal of World Affairs*, Vol.4, No.1, Winter/Spring 1997, pp.103-126, p.112.

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program. In the following weeks, Iraqi officials took inspectors to Kamel's farm, revealing hundreds of thousands of pages of documents that detailed Iraqi weapons efforts. Through a combination of Iraqi declaration and analysis of the recovered documents, weapons inspectors learned that Iraq had weaponized biological agents, had a more advanced indigenous ballistic missile program than previously believed, had produced more chemical weapons than disclosed earlier, and had initiated a crash program in 1990 to try to acquire a nuclear weapon in less than a year.

After serious problems related to inspection of presidential sites and charges that some inspectors who worked for UNSCOM were spying on Iraq for the United States, the whole inspection process came to a complete halt and both the IAEA and UNSCOM withdrew their personnel from Iraq in December 1998. This was followed by three-day air strikes of specific targets by the United States and the United Kingdom. This military operation, known as Desert Fox, did not change Iraq's determination to ban inspectors working for UNSCOM from entering the country again and resume their work. In an apparent attempt to break the stalemate, the Security Council passed Resolution 1284 in December 1999, creating a successor to UNSCOM – the United Nations Monitoring, Verification, and Inspection Commission (UNMOVIC). The resolution demanded that UNMOVIC be given unconditional and unrestricted access. It also demanded that within 60 days of their entry into Iraq, UNMOVIC and the IAEA draw up a list of key remaining disarmament tasks so that Iraq would know exactly what it had to do to comply fully. Iraq rejected Resolution 1284 and the deadlock continued.

In a last attempt to convince Iraq to comply fully with the disarmament resolutions, the Security Council passed Resolution 1441 unanimously in November 2002. The new resolution called on Iraq to implement all existing Security Council resolutions related to WMD. The executive chairman of UNMOVIC and the director general of IAEA reported to the Security Council the progress on the implementation of this resolution. Iraq accepted the resolution and international inspectors were allowed back into the country. Dissatisfied with the Iraqi compliance, the United States led an international coalition that toppled

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the Saddam Hussein regime and occupied Iraq in March 2003.

Two conclusions can be drawn from these twelve years (1991-2003) of international efforts to disarm Iraq. First, many observers and governments disagree on how much progress was made in disarming Iraq by international inspectors from 1991 to 2003. However, there is consensus that Iraq had consistently failed to comply fully and unconditionally with Security Council Resolution 687. Second, several months after the American-led international coalition's invasion of Iraq, serious questions were raised about the quality of American intelligence and there were speculations that data on Iraq's WMD were manipulated to support a pre-emptive war.

Despite some uncertainties regarding the magnitude of Iraq's WMD programs and capabilities prior to the 2003 war, the assessment of both the IAEA and UNSCOM raised serious questions and concerns, which were never completely satisfied. First, pre-invasion Iraq did not sign the Comprehensive Test Ban Treaty (CTBT), but ratified the Non-proliferation Treaty (NPT), pledging not to manufacture NW and agreeing to place all its nuclear materials and facilities under IAEA safeguards. Iraq violated its NPT obligations, however, by secretly pursuing a multi-billion-dollar nuclear weapon program. The IAEA inspectors were largely successful in obtaining a relatively complete picture of the Iraqi nuclear weapons program and dismantling it. The IAEA, which removed from Iraq all known fissile material that could be used to make weapons, reported that there were no indications that meaningful amounts of weapon-usable material remained in the country or that it possessed the physical capability to produce significant amounts of such material indigenously. But the IAEA cautioned that because nuclear weapons material or infrastructure could be hidden, it could not verify with absolute certainty that Iraq had no prohibited materials.

Second, Iraq did not sign the Chemical Weapons Convention (CWC). Its production of CW began in the early 1980s and weaponized mortar shells, artillery shells, grenades, aerial bombs, and rockets for chemical use. UNSCOM admitted it could not verify that Iraq's declarations about its total past procurement and production of chemical precursors and agents were true because of a lack of docu-

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mentation and information on these activities from both Iraq and its foreign suppliers. UNSCOM also noted it had little information on actual Iraqi military plans, deployment, and use of its CW, making it difficult to say with certainty what types of and how many CW Iraq had.

Third, Iraq acceded to the Biological and Toxin Weapons Convention (BWC). In 1991 the Iraqi government declared that it did not possess any BW or related items. UNSCOM's findings, strengthened by information obtained in 1995 from Hussein Kamel's defection, eventually revealed that Iraq's BW program was well developed, encompassing all aspects of BW development from research to weaponization. UNSCOM repeatedly declared that it had no confidence that all bulk agents had been destroyed, that no BW munitions or weapons remained in Iraq, and that a BW capability did not still exist in Iraq. UNSCOM also warned that Iraq possessed an industrial capability and knowledge base through which biological warfare agents could be produced quickly and in volume, if the government of Iraq decided to do so.

Fourth, Iraq's ballistic missile program was essentially developed during the war with Iran in the 1980s. In less than eight years, Baghdad constructed a sophisticated missile program from what might be described as a standing start.[7] Thus, before the Gulf war, Iraq had extensive short-range ballistic missile capabilities, including a stockpile of Soviet-supplied Scud-Bs and indigenously produced ones. Security Council Resolution 687 mandated that Iraq eliminate ballistic missiles with ranges exceeding 150 kilometers. UNSCOM supervised or accounted for the destruction of 817 of 819 proscribed ballistic missiles imported by Iraq before the Gulf war as well as all of Iraq's declared operational mobile missile launchers. UNSCOM, however, warned that Iraq continued to work on its proscribed programs and even initiated new projects while inspectors were in the country.

All these strong concerns and unanswered questions raised by the IAEA and UNSCOM came to an end with the toppling of Saddam

[7] Mark H. Kagan, "Iraq's Case: The International Missile Trade and Proliferation," in William C. Potter and Harlan W. Jencks (eds), *The International Missile Bazaar: The New Suppliers' Network*, Boulder, CO: Westview Press, 1994, pp.181-200, p.196.

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Hussein's regime. The 2003 war opened a new chapter in Iraq's domestic and foreign policies. The question of WMD in post-Saddam Iraq will take some time to be fully addressed. Still some preliminary observations can be made. First, many analysts argue that even if all of Iraq's WMD were destroyed the danger is still there. The heart of the problem lies in the know-how (i.e., the Iraqi scientists and engineers), not the equipment. This Iraqi workforce, however, has been denied the opportunity to update and expand its expertise since the Gulf war. The Iraqis cannot maintain their knowledge without periodic experimentation. The level of expertise acquired by these scientists and engineers will gradually decay. Furthermore, it is almost certain that post-Saddam Iraq will not be allowed to possess non-conventional capabilities.

Second, the issue of WMD in post-Saddam Iraq should take into consideration regional policy. Long before Saddam rose to power, Iraqi leaders saw Iran and Israel as adversaries. These two countries possess a variety of conventional and non-conventional weapons. The relations between post-Saddam Iraq on the one side and Iran and Israel on the other will certainly shape the debate over Iraqi national security and the need for, or lack of, WMD. Put differently, the development of WMD by Iraq is not only attributable to Saddam Hussein's bid for regional hegemony but also to a genuine feeling of being threatened by powerful neighboring states.

Third, the continuous vigorous American efforts since March 2003 to find the alleged Iraq's WMD have produced no results. Statements by detained Iraqi leaders and scientists assert that their country did not possess stocks of chemical, biological or nuclear weapons on the eve of the war. To date, no evidence has been found that Saddam Hussein was willing to risk being caught in major defiance of U.N. bans on WMD since the late 1990s. This conclusion has been confirmed by top international experts. Hans Blix, the former senior weapons inspector in Iraq, said that he believed Iraq had destroyed its unconventional weapons in the mid-1990s but kept up the appearance that it had them to deter a military attack. Similarly, Mohamed El-Baradei, the IAEA's chief, reiterated that the U.N. inspectors found Iraq's nuclear program in disarray and in no position to build a nuclear weapon.

Finally, the toppling of Saddam Hussein's regime is considered a

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great security advantage to Israel. Tel Aviv does not need to worry any more about nuclear, biological, or chemical threats from Baghdad. In addition, the decisive American military action sent an unmistakable message to a would-be proliferator (i.e., Iran) that the United States will not tolerate a new nuclear power in the Middle East. The question is: Will Iran get the message?

Iran

The toppling of Saddam Hussein's regime meant, among other things, that any chemical, biological and nuclear threat Iraq posed to its neighbors had been neutralized, at least in the short term. It is little wonder, then, that more international attention has been focused on the other giant Persian Gulf state – Iran. Under Saddam Hussein's leadership, Iraq acquired chemical and biological weapons and had an active nuclear program and hundreds of ballistic missiles. In addition, Baghdad used, or threatened to use, these weapons. Iran is a different story. Tehran signed several of the major non-proliferation treaties including the CWC, the BWC, and the NPT, and since the mid-1970s has called for making the whole Middle East a nuclear-free zone. Furthermore, Iran has suffered more from CW at the hands of the Iraqis than any other nation in the world since the end of First World War. Finally, Iranian strategists are concerned about the proliferation of WMD in neighboring countries, particularly Pakistan, a large Sunni Muslim country; Israel, an arch-enemy; and of course Iraq (to the extent it ever resumes what it was before the 2003 war).

Despite this dangerous neighborhood, Iranian officials categorically deny any interest in or possession of WMD. Israel, the United States, and other countries believe, however, that Iran has a large stockpile of CW and BW as well as an active program to manufacture nuclear explosives. Iran and its critics agree, though, about the country's active and ambitious missile program. Iranian officials are not shy about confirming and displaying their growing missile capabilities. Iran is not a party in any international treaty that would limit its capacity to develop missiles.

This section examines Iran's motives and incentives to acquire WMD. Then, a brief review of Iranian efforts to manufacture these

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weapons is provided and an assessment is given of the country's chemical, biological, and nuclear capabilities as well as its missile program. American efforts to stop or slow down Iranian non-conventional capabilities will be analyzed. Finally, the question of the strategic impact of a potential "nuclear Iran" will be addressed.

An examination of Iran's motivations to acquire and develop WMD reveals a deep concern about national security within a regional and international context that has grown more hostile and dangerous to the Islamic regime since the revolution in 1979. Put differently, Iranian strategists feel threatened by the growing non-conventional capabilities of several of their neighbors, as well as by the deployment of American troops next to their borders in almost all directions. The lesson that the Iranians have learned from their own experience and that of other countries is that conventional weapons probably will not suffice to ensure their national security and deter potential attacks. Instead, chemical, biological, and nuclear capabilities and the means to deliver them will prevent the country's potential and real enemies from threatening core Iranian national interests.

Turkey is located on the northwestern borders of Iran. Despite overall good relations between Ankara and Tehran, there are fundamental differences in their domestic and foreign policy orientations with clear implications on their national security. While Turkey is a staunch believer in secularism and the Turkish army stands firm to prevent religious penetration of Turkish public life and policy, the Iranian regime's legitimacy is based on its adherence to the Islamic principles and tenets. In short, Turkey is a secular state, while Iran is a religious theocracy. In addition, Turkey is a traditional ally of the United States and a member of NATO (North Atlantic Treaty Organization), and since the mid-1990s has forged a military and economic alliance with Israel. Both the United States and Israel are Iran's sworn enemies. Finally, since the collapse of the Soviet Union in 1991, Turkey and Iran have pursued competing economic and political strategies in Central Asia. Despite these basic differences, these two Muslim, non-Arab Middle Eastern states have established good relations and avoided any serious military confrontation. Furthermore, Iran greatly appreciated Turkey's refusal to allow American troops to use its military bases to

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attack Iraq in the 2003 war. Still, a Turkish military threat to Iran cannot be ruled out. Ankara features in Tehran's national security calculus.

Russia is located to the north of Iran. Historically, the Soviet Union/Russia has always posed a threat to the stability and territorial integrity of Iran. In the past two centuries Iran has lost substantial territory to the Soviet Union/Russia. During the Cold War, the Pahlavi regime strongly resisted Soviet attempts to penetrate the Middle East and promote communism. Since the early 1990s, Russia has become one of Iran's closest allies. Indeed, Russia has helped Iran build its conventional and non-conventional capabilities. Nevertheless, Moscow and Tehran have taken opposite stands on basic issues. Russia is a main trade partner to Israel and has special relations with the Jewish state due to the approximately one million Soviet Jews who immigrated to Israel. Besides, Russia and Iran pursue competing policies in the Caspian Sea. The two nations disagree on the legal status of rights to the Caspian Sea and also disagree on the oil pipeline routes. These disagreements can threaten the current cooperative relations between Moscow and Tehran.

Pakistan, a nuclear power, is on the eastern borders of Iran. The great majority of Iranians are Shi'ia, and Pakistan is one of the largest Sunni countries. Until the September 11, 2001, terrorist attacks in the United States, Iran and Pakistan took opposite sides in the civil war in neighboring Afghanistan. Islamabad supported the Taliban – an extremist Sunni movement – while Tehran supported the Northern Alliance – a group of opposition groups that included the Afghani Shi'ias. Meanwhile, Pakistan is a close ally to the United States, and Iran established close economic and military cooperation with India, Pakistan's main rival.

On its southern borders, Iran shares the Persian Gulf with the Arab Gulf monarchies. Since the Iraqi invasion of Kuwait in 1991, Iran and its Arab neighbors have come closer and have signed several agreements to consolidate their cooperation. Despite this Arab-Iranian rapprochement, there are basic problems beneath the surface. Most of these Arab Gulf states have large Shi'ia minorities that have not been completely assimilated. Most of Arab Gulf rulers have forged strong defense links with the United States. They see Washington as their main defender against external threats, and allow American troops and facilities in their

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countries. They supported Iraq in its war with Iran and they have bought some of the most sophisticated weapon systems in the world. Their military spending is less restrained by financial and political pressure than Iran. Finally, Iran has a standing territorial dispute with the United Arab Emirates, supported by the other Gulf monarchies, over three islands – the Greater Tunb, the Lesser Tunb and Abu Mussa.

Since the early 1990s, Iran has had good relations with most of these neighbors – Turkey, Russia, Pakistan, and the Arab Gulf states. A military threat from these countries to the Islamic Republic is unlikely in the foreseeable future. Still, deterioration of relations cannot be ruled out. Iranian strategists include these potential adversaries in drawing their national security plans. They saw more realistic threats as coming from the United States, Israel, and Iraq, and it was their fear of these three countries that was the main reason for Iran having sought a non-conventional arsenal since the mid-1970s.

Since the Islamic Revolution in 1979, Tehran and Jerusalem have seen each other as committed enemies. Iran, even under the Shah, opposed the Israeli nuclear asymmetry in the Middle East and Israel's refusal to sign the NPT. Accordingly, the Pahlavi regime sought to establish its own nuclear program and, as an alternative, called for the creation of a Middle East Nuclear Free Zone (MENFZ). The leaders of the Islamic regime in Tehran perceive Israel as having the most extensive chemical, biological, and nuclear arsenal in the Middle East as well as a formidable conventional force, which has the reputation of being one of the most combat-effective forces in the world. Within this context, an Iranian non-conventional capability can serve as a deterrent against potential Israeli attacks.

In response, senior Israeli military officials and politicians have been explicit about the need to quash Iran's WMD facilities, particularly the nuclear ones. These Israeli threats are credible for three reasons. A) Israel's pre-emptive attack on Iraq's nuclear reactor in 1981 serves as a precedent. B) Israel's capability to carry out long-range attacks has been substantially enhanced in the last several years. Since the late 1990s, Israel has acquired a number of cruise-missile-capable diesel submarines and further developed its extended-range Jericho missiles. C) As a result of its growing military cooperation with Turkey, Israel effectively has a

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presence on the Turkish border with Iran; it reportedly operates intelligence-collection facilities there, and Israeli reconnaissance or strike aircraft could over-fly Turkey en route to Iran.[8]

These threats and counter-threats made by Iranian and Israeli officials have substantially heightened tension between the two countries. A direct military confrontation between Tehran and Jerusalem is likely to take place under one of two scenarios: first, an Israeli pre-emptive attack against Iran's WMD infrastructure; second, a large-scale terrorist attack against Israeli or Jewish targets carried out by the Lebanese guerrilla Hizbollah (Party of God) or other Palestinian organization, and sponsored by Iran. These two scenarios for direct military confrontation between Iran and Israel are, however, unlikely. Differences over the Israeli-Palestinian issue aside, the two countries have no specific or direct dispute with each other.[9] Still, they will remain highly concerned about each other's conventional and non-conventional military capabilities.

Iran has had hostile relations with the United States since the monarchy was overthrown in 1979. Since then, the Islamic Republic has held an almost paranoid and conspiratorial view of the United States' role and action in the Middle East and has seen almost every U.S. initiative as a direct or indirect assault on Iran's national interests.[10] Indeed, confronting the United States is one of the few remaining legitimizing symbols for the Islamic Republic. Iran's strategic stand on the international system has worsened since the collapse of the Soviet Union in 1991 and the emergence of the United States as the sole superpower. In the post-Cold War environment, there is no other superpower to balance the United States. This unchecked sole superpower has been very suspicious of Iran's intentions and nuclear program.

Since the early 2000s, the mutual suspicion between Washington and Tehran has grown. In October 2001, American troops were

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[8] Michael Eisenstadt, "Living with a Nuclear Iran?" *Survival*, Vol.41, No.3, Fall 1999, pp.124-148, p.129.

[9] Daniel Byman, Shahram Chubin, Anoushiravan Ehteshami, and Jerrold Green, *Iran's Security Policy in the Post-Revolutionary Era*, Santa Monica, CA: RAND, 2001, p.85.

[10] Anoushiravan Ehteshami, "Tehran's Tocsin," *Washington Quarterly*, Vol.23, No.3, Summer 2000, pp.171-176, p.172.

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deployed to Afghanistan and overthrew the Taliban regime. Less than two years later, in March 2003, American troops were deployed in Iraq to topple Saddam Hussein's regime. Despite the fact that both the Taliban and Saddam Hussein were regarded as enemies by Iran, the American military presence on Iran's eastern and western borders (as well as in the Arab Gulf states on the southern borders and in Central Asia on the northern borders) is a matter of great alarm and concern to the regime in Tehran. In short, since the early 2000s Iran has been encircled by American troops from almost all directions. Tehran's sense of encirclement feeds into its fear and suspicion of Washington's intention toward the Islamic regime. In the aftermath of the 2003 war in Iraq, many Iranian officials and intellectuals have expressed their concern that their country would be the next on President Bush's list for regime change.

For a long time, Iran and other Arab states have argued that there is a double standard in U.S. policy concerning nonproliferation. Iranian officials accuse the United States of pursuing a policy of "selective proliferation" by saying nothing about Israel's nuclear capability (Israel is not a signatory to the NPT), while harshly criticizing and imposing sanctions on Iran, which signed the NPT. The American-led war in Iraq in 2003 has reinforced these Iranian accusations. The war sent a mixed signal to Tehran. On one hand, the United States was not provoked to attack Iraq; rather, it was a pre-emptive strike. This clearly suggests that Washington is ready to use its overwhelming might to prevent the proliferation of WMD. On the other hand, the United States' more benign and less confrontational response to North Korea's nuclear activities suggests that acquiring a nuclear device can serve as a deterrent. Some members in the Iranian political/security establishment believe that a nuclear capability is the only guarantor of the nation's independence and the regime's survival. The aim of acquiring such capability would be to deter the United States before it "bullies" the Islamic Republic.[11]

Finally, pre-invasion Iraq probably represented the most salient

[11] Shahram Chubin, "Does Iran Want Nuclear Weapons?" *Survival*, Vol.37, No.1, Spring 1995, pp.86-104, p.91.

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incentive for Iran's drive to acquire and develop WMD. Most of the Iranian efforts to obtain such capabilities started during the war with Iraq (1980-88). During the war, Iraq launched chemical and ballistic missile attacks on Iranian army and population centers, and it has since been revealed that Iraq also had an extensive biological warfare program. Then, Iran's arsenal of these weapons was no match for Iraq's. The existence of a hostile neighboring state with a known chemical and biological capability was an incentive to develop a deterrent in kind.[12] This bloody conflict ended with a cease-fire, which had not been formalized into a peace treaty before the American invasion of Iraq.

Indeed, the underlying reasons for the conflict are deep-rooted and have not been adequately resolved. The two nations still have a territorial dispute over Shatt al-Arab; and the demographic structure will always be a factor in shaping their relations. The majority of Iraqis (about 60 percent) are Shi'ia and (40 percent) are Sunni, while more than 90 percent of the Iranians are Shi'ia. This means that Iran will always have the potential to influence Iraqi domestic policy. Furthermore, the two big and powerful states – Iran and Iraq – have had their own conflicting ambitions to dominate the rich and small Arab Gulf states.

Given these roots of enmity, Tehran and Baghdad have always been suspicious of each other. This hostility characterized their relations before Saddam Hussein and is likely to continue in post-Saddam Iraq. As one analyst put it, "Scenarios of renewed conflict with Iraq are not far-fetched."[13] Iran is wary of the uncertainty regarding post-Saddam Iraq. The Iranians learned an important lesson by comparing their war with Iraq (1980-88) and the Gulf war (1991). Iraq used CW against Iran because the latter could not retaliate in kind. In the Gulf war Iraq did not utilize its WMD because the international coalition had the capability to retaliate in kind. The lesson is that for deterrence to

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[12] Saideh Lotfian, "Threat Perception and Military Planning in Iran: Credible Scenarios of Conflict and Opportunities for Confidence Building," in Eric Arnett (ed), *Military Capacity and the Risk of War: China, India, Pakistan and Iran*, London: Oxford University Press, 1997, pp.195-215, p.199.

[13] Shahram Chubin, *Iran's National Security Policy: Intentions, Capabilities & Impact*, Washington, D.C.: The Carnegie Endowment for International Peace: 1994, p.49.

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operate, the threatening state must be confronted with the certainty of an equivalent response.[14] Iran has developed non-conventional capabilities to deter Iraq.

The roots of Iran's pursuit of WMD lie in the closing years of the Iran-Iraq War, though the Shah had previously laid the groundwork for an indigenous Iranian nuclear capability during the 1970s. Officially, Iranian policy-makers insist that their country does not possess and has no interest in developing such capability. Israel, the United States and other countries do not believe Iran's proclamations and accuse Tehran of stockpiling these deadly weapons.

In response to Iraq's chemical attacks on Iranian targets, Tehran felt the need for in-kind retaliation. Thus, Iran undertook a serious effort to develop its own arsenal of CW. Iranian officials argue with considerable emotion that they, more than any other country, are determined to eliminate this class of weaponry. More than three decades after the war with Iraq, thousands of Iranians still suffer from chronic illnesses and genetic disorders caused by Iraqi chemical attacks. In 1998, Iran disclosed that it had a chemical weapons program in the closing years of the war with Iraq and provided information to the CWC. The following year, Iran invited an inspection team from the Technical Secretariat of the CWC to visit and examine its declared sites and facilities. In a well-publicized gesture of full compliance, Iran voluntarily destroyed these facilities in the presence of the visiting team.[15] Despite these steps, it is worth repeating, Israeli and Western sources believe that Iran has rebuilt and further developed its arsenal of CW.

The case of BW is similar to CW. Iran's biological weapon program was initiated during the war with Iraq. Development of biological capabilities was made easier because of the dual-use nature of many of the components necessary for such weapons. Like everyone else, Iran claims that it is in compliance with the BWC. However, unlike the CWC, the BWC has no verification mechanism in place. Few Israeli and

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[14] Shahram Chubin, "Does Iran Want Nuclear Weapons?" *Survival*, Vol.37, No.1, Spring 1995, pp.86-104, p.94.

[15] Muhammad Javad Zarif and Muhammad Reza Alborzi, "Weapons of Mass Destruction in Iran's Security Paradigm: The Case of Chemical Weapons," *Iranian Journal of International Affairs*, Vol.9, No.4, Winter 1999, pp.511-523, p.519.

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Western analysts believe the Iranian assurances.

The most controversial issue regarding Iran's WMD is its nuclear program. Ironically, this program began with the assistance of the United States. In 1957 Iran signed a civil nuclear cooperation agreement with Washington as part of the U.S. Atoms for Peace Program. Few years later, Iran arranged to buy a research reactor from the U.S., and this began operation in 1967. Washington also sold Tehran a number of hot-cell laboratories for handling radioactive materials. In 1974, the Shah established the Atomic Energy Organization of Iran and stated that Iran would have nuclear weapons without a doubt very soon.[16] It is important to point out that in this early stage of building Iran's nuclear capability Israel was not the target. Rather, the Pahlavi regime wanted to deter regional powers such as Egypt and Iraq.

In addition to this assistance from the United States, Iran's nuclear program received contributions from France and Germany. They signed several agreements with the Shah to provide Iran with enriched uranium, nuclear reactors and research centers.[17] A significant step in building Iran's nuclear capability was the signing of an agreement with the two German firms – Siemens and Kraftwerk Union – to build two nuclear reactors in Bushehr, a port city along the Persian Gulf. Construction of these reactors, which were 80 and 65-70 percent complete, was frozen by Ayatollah Khomeini immediately after the 1979 revolution.[18] The Iranian leader considered NW (as well as CW and BW) immoral and decided not to seek them. In 1985, however, Iran decided to restart its nuclear program. The search for uranium was stepped up and Tehran began offering incentives for exiled Iranian nuclear scientists to return home. It was little wonder that Bushehr became a major target for Iraqi raids. The reactors were substantially damaged by Iraqi bombardments.

In the aftermath of the Iran-Iraq war, Tehran sought to revive its

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[16] Jacqueline Simon, "United States Non-Proliferation Policy and Iran: Constraints and Opportunities," *Contemporary Security Policy*, Vol.17, No.3, December 1996, pp.365-394, p.371.

[17] Judith Perera, "Iranian Nuclear: The Battle of Bushehr," *Energy Economist*, No.223, May 15, 2000, pp.17-20, p.18.

[18] Greg J. Gerardi and Maryam Aharinejad, "Report: An Assessment of Iran's Nuclear Facilities," *Nonproliferation Review*, Vol.2, No.3, Spring-Summer 1995, pp.207-213, p.208.

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nuclear program and finish the construction of the Bushehr reactors. The opening of Iran's first nuclear engineering center in 1992 can be seen as a sign of these renewed efforts to obtain nuclear knowledge.[19] Under American pressure, the German firms refused to resume work on the projects. Iran sought assistance from many other sources, including China, India, Brazil, the Czech Republic, Ukraine, and Kazakhstan. The threat of U.S. sanctions, however, blocked the participation of these potential partners in Iran's nuclear program. Finally, in early January 1995, Iran signed an $800 million deal with Russia to complete the first of the two units at Bushehr. In response to U.S. pressure, Russia later negotiated with Iran a separate agreement stipulating that all spent fuel from the Bushehr reactors would be shipped back to Russia.

U.S. diplomats tried to persuade Russia not to go ahead with the Bushehr project on three grounds. First, the knowledge gained by Iranian scientists working at Bushehr could indirectly assist a weapons program. Second, weapons grade plutonium could be extracted from the reactor, allowing the Iranians to construct nuclear weapons. Third, Iran's commitment to the NPT could not be trusted. The Russians responded to these American warnings by themselves underscoring three points. First, the light water reactor technology they were selling to Iran was essentially the same type of nuclear technology that Washington had agreed to provide North Korea in the October 1994 Agreed Framework.[20] Second, the Bushehr agreement included provisions for Russia to supply fresh fuel for the life of the reactor and to take spent fuel back to Russia, thus denying Iran any potential access to the plutonium contained in the spent fuel. Third, from a strategic prospective, Iran is a close neighbor to Russia. Moscow does not wish to see a nuclear Iran right in its backyard. By working with Iran, the argument goes, Russia hopes to keep close eye on the nuclear program there.[21]

Seen from Moscow, nuclear cooperation with Iran is important for

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[19] Anoushiravan Ehteshami, *After Khomeini: The Iranian Second Republic*, London: Routledge, 1995, p.189.

[20] Robert J. Einhorn and Gary Samore, "Ending Russian Assistance to Iran's Nuclear Bomb," *Survival*, Vol.44, No.2, Summer 2002, pp.51-70, p.53.

[21] David Albright, "An Iranian Bomb?" *Bulletin of the Atomic Scientists*, Vol.51, No.4, July/August 1995, pp.21-26, p.23.

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obvious economic incentives as well as geopolitical reasons. Iran is a key player in the Persian Gulf, Central Asia and the overall Islamic world. The good relations between Moscow and Tehran have helped convince the latter to play a moderating role among Russia's Muslim population, particularly in Chechnya. Both nations have adopted similar stands in Afghanistan and the Caucuses.

The American response to this Russian-Iranian nuclear cooperation can be described as a stick and carrot approach. On the one hand, the United States has offered to work with Russia on several economic and strategic projects if it cuts off its nuclear assistance to Iran. The message is that Russia has far more to gain, both economically and politically, by aligning its policies with Washington than by maintaining its nuclear cooperation with Tehran. On the other hand, the United States has imposed sanctions on several Russian companies for providing nuclear materials and expertise to Iran.

The bottom line is the United States' belief that, despite strong denials, Iran is pursuing efforts to attain nuclear capability. In June 2003, President Bush bluntly stated that the United States and its allies "will not tolerate the construction of a nuclear weapon in Iran."[22] American officials believe that there is no economic justification for a state that is so rich in oil and gas, like Iran, to build these hugely expensive nuclear fuel cycle facilities. The Iranians respond by confirming that they are interested in nuclear power for peaceful purposes and that it will help free up oil and gas resources for export, thus generating additional hard-currency revenues. Furthermore, Iran does not want to fall behind in the nuclear industry, with its wide-ranging applications; and Iranian technicians need to familiarize themselves with this technology. Finally, Iran maintains that as a party to the NPT it has a right to obtain nuclear technology for peaceful purposes.

In order to ensure that Iran is not trying to develop nuclear weapons and is in compliance with the NPT, the United States, the European Union, Russia, and the IAEA have demanded that Iran sign the IAEA

[22] David E. Sanger, "Bush Warns Iran on Building Nuclear Arms," *New York Times*, June 19, 2003, on line at www.nytimes.com.

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Model Safeguards Protocol. This document was devised after the discovery of Iraq's clandestine nuclear weapons program and contains measures designed to permit IAEA inspection of undeclared nuclear sites as well as the declared sites that are already the subject of the basic IAEA inspection regime. In addition, the protocol contains language that enables the IAEA to conduct inspections in the subject country in order to investigate the accuracy of suspicions that have been brought to the attention of the IAEA by another IAEA member state.

The debate about Iran's nuclear program was intensified in the summer of 2003 with the revelation that traces of bomb-grade uranium had been found at two facilities in Iran. The amount of plutonium at issue is in micrograms – nowhere near what is needed for a warhead. But experts and diplomats said the key point was that the Iranians were developing the techniques to extract much more plutonium. Under heavy international pressure, Iran acknowledged that it has been developing, for 18 years, a uranium centrifuge enrichment program and for 12 years, a laser enrichment program. Following a visit by the foreign ministers of France, Britain, and Germany to Tehran in October 2003, and in an attempt to underline its new cooperation, Iran informed the IAEA that it was ready to sign the additional protocol to the NPT and was suspending its uranium enrichment and reprocessing activities. Finally, in late November 2003 the Board of Governors of the IAEA adopted a resolution that emphasized that in order to restore confidence, Iranian cooperation and transparency will need to be complete and sustained so that the Agency can resolve outstanding issues and, over time, provide and maintain the assurances required by the member states. The resolution added that should any further serious Iranian failures come to light, the Board of Governors would meet immediately to consider all options at its disposal, in accordance with the IAEA Statute and Iran's Safeguards Agreement.

These real or potential chemical, biological, and nuclear devices are likely to be delivered by missiles. Ironically, the origins of the Iranian missile program can tenuously be said to date back to the closing years of the Pahlavi regime and the joint Israeli-Iranian "Project Flower." This project was concerned with the development of missiles. In 1978 Iran made a down payment for "Project Flower" by providing Israel with

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$280 million worth of oil and began the construction of a missile facility near Sirjan, in south central Iran.[23] The collapse of the monarchical regime dealt a fatal blow to the project.

Thus, at the time of the 1979 revolution, Iran had no artillery, rocket or ballistic missile capabilities to speak of. The escalation of the Iraqi use of missiles against Iranian targets persuaded Iran to acquire such capability. The two countries launched missile attacks against each other's population centers in what became known as "the war of the cities." Iraq's superior missile arsenal contributed to its victory and forced Iran to accept a cease-fire. This outcome further strengthened Iran's determination to develop its missile program both indigenously and in cooperation with foreign suppliers.

During the war with Iraq, Iran relied primarily on Soviet SCUD-Bs, which were bought from Libya and Syria. In the late 1980s, Iran built factories to assemble and manufacture different types of North Korean and Chinese ballistic missiles.[24] Iran has also been at the forefront of regional efforts to develop cruise missiles.[25] In the early 2000s, it is believed that Iran possesses and can manufacture both ballistic and cruise missiles.[26] In the mid-1990s, Iran started to develop long-range ballistic missiles known as Shehab ("meteor" in Farsi).[27] Missile tests and the development of a new generation of Shehab rockets have added to Israel's concerns. In May 2002 the Iranians succeeded in striking a predetermined target for the first time.[28] A year later (2003), the missiles went into service. The success of the missile's range and guidance

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[23] Joseph S. Bermudez, "Iran's Missile Development," in William C. Potter and Harlan W. Jencks (eds), *The International Missile Bazaar: The New Suppliers' Network*, Boulder, CO: Westview Pess, 1994, pp.47-74, p.48.

[24] Ballistic missiles are guided rockets that are powered only for the first part of the flight. Thereafter, they coast (on a ballistic trajectory) to their targets.

[25] Cruise missiles generally look like small airplanes and may be powered by rockets or air-breathing engines. Unlike ballistic missiles, cruise missiles are powered (that is, they cruise) all the way to their targets.

[26] Richard Speier, "Iranian Missiles and Payloads," in Geoffrey Kemp (ed), *Iran's Nuclear Weapons Options: Issues and Analysis*, Washington, D.C.: Nixon Center, 2001, pp.55-62, p.57.

[27] Aaron Karp, "Lessons of Iranian Missile Programs for U.S. Nonproliferation Policy," *Nonproliferation Review*, Vol.5, No.3, Spring-Summer 1998, pp.2-12, p.8.

[28] International Institute for Strategic Studies, *The Military Balance 2002-2003*, London: Oxford University Press, 2002, p.98.

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reflected improvements made by North Korea to the Shehab 3 engine, navigational and guidance systems, as well as in systems integration. Iran regards its missile programs as an important adjunct of both its political and security policy.

In closing, it is better not to speculate on when and if Iran will possess nuclear devices. Intelligence services around the world are striving to answer such questions. Instead, three broad interrelated conclusions can be drawn from this discussion of Iran's non-conventional capabilities. First, Iranian efforts to acquire and develop WMD are not tied to the current regime. The country's nuclear program started when the Shah was in power. The war with Iraq and Saddam Hussein's chemical and missile attacks on Iranian targets, that were not condemned by the international community, left the regime in Tehran with no other option but to develop in-kind retaliation. Any regime in Tehran, Islamic or imperial, most likely would have reacted in a similar way. A regime change in Iran would not necessarily mean that the country would give up its WMD aspirations and programs. Hence, the problem is likely to outlast the current regime.

Second, most analysts agree that Iran possesses CW and BW and has developed indigenous capability to assemble and manufacture different types of missiles. There is also consensus that Iran has not yet developed nuclear capability. Israel and the United States accuse Iran of trying to make nuclear weapons; Russia, the European Union, and the IAEA have expressed serious concerns regarding Iran's intentions; and Iran categorically denies any interest in making nuclear weapons. There is also disagreement about how a nuclear capability might influence Iran's international policy. In other words, if and when Iran acquires nuclear explosives, will it act differently? To answer this question, three points should be considered: A) It is impossible to know in advance what impact the acquisition of nuclear weapons will have on Iranian policy. B) Many analysts reject the argument that the Iranian leadership is irrational and undeterrable.[29] Irrationality is not the real problem.

[29] For example see Shahram Chubin, *Iran's National Security Policy: Intentions, Capabilities and Impact*, Washington, D.C.: Carnegie Endowment for International Peace, 1994. And, Michael Eisenstadt, "Living with a Nuclear Iran?" *Survival*, Vol.41, No.3, Fall 1999, pp.124-148.

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Rather, it is the fragmentation of the Iranian religious/political leadership. In both domestic and foreign policy, Iran speaks with more than one voice. A nuclear Iran, if and when it exists, is not likely to rush to nuclear war. Concern about retaliation and international reaction would be taken into consideration. Furthermore, the Iranian style is more about acting through surrogates (such as Hizbollah in Lebanon, Hamas in Israel, the Northern Alliance in Afghanistan, and the Shi'ias in Iraq) and less about direct confrontation. C) Despite these reservations, a nuclear Iran is not a desirable development. Such a step would contribute to uncertainty and instability in the Middle East and the rest of the world.

Third, there is the question of how to deal with the proliferation of WMD in Iran. Regional and international powers agree that Iran armed with WMD would pose a threat to stability and peace. However, there is no consensus on how to slow or eliminate these capabilities. Washington has relied on economic sanctions and diplomatic pressure without ruling out a military option. Similarly, some Israeli officials have raised the possibility of a pre-emptive strike like the one on the Iraqi nuclear reactor in 1981. Russia and the European Union have sought to change Iranian policy through engagement. The latter is Iran's main trade partner and is negotiating a comprehensive trade agreement with Tehran. The utilization of economic, political, and military tools suggests that different strategies should, and have, been implemented. Traditional tools such as export controls are likely to be insufficient. Iran has already made significant progress in acquiring the materials and indigenous expertise it needs to manufacture WMD. A long-term approach to address the issue of Iran's WMD will depend on encouraging economic and political reform within the country, and on taking steps to reduce regional tension and to solve the underlying reasons for conflict in both the Persian Gulf and the Arab-Israeli dispute.

Conclusion

Three conclusions can be drawn from this discussion of non-conventional military capabilities and motivations of Iraq and Iran. First, the Middle Eastern military and strategic environment is in the process of deep-rooted changes. The fall of the Saddam Hussein regime has

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drastically altered the region's strategic landscape. Post-Saddam Hussein Iraq is unlikely to threaten its neighbors with WMD. Certainly this is a positive development for regional and world peace, and since the 2003 war more attention has been focused on Iran's WMD. Second, the Arabs and Iranians have not been able to balance the Israeli nuclear program with a similar one of their own. Therefore, they have developed chemical and biological capabilities as the best alternative available to them. They will seek to maintain these weapons as long as Israel keeps its nuclear explosives. Third, in the long run, there is no substitute for addressing the underlying reasons for conflict in the Persian Gulf and the Arab-Israeli dispute. A fair political settlement of the latter is bound to be conducive to effective arms control and non-proliferation.

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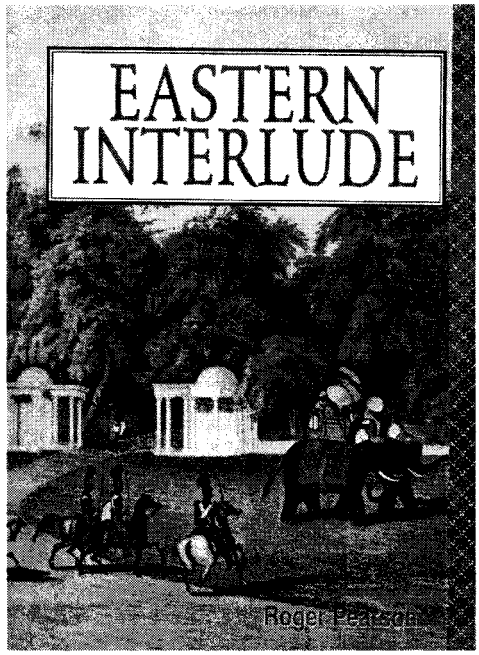

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An Examination of Gender Asymmetry in Divorce: an Extension of Fisher's Thesis

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Fisher profiled the broad outlines of the relationship between men and women in the "sex contract": courting, marriage, and divorce. This article examines selected dynamics of divorce to extend the basics of Fisher's thesis. The argument is presented that, although the genders have a reciprocal relationship with each other, the reciprocity is not symmetrical. The relationship is asymmetrical. In the context of the development of romantic love (limerence), the social father, and paternal certainty, plus the cultural overlay of marriage upon pair-bonding, it is suggested that, across the millennia, the range of options from which the woman would choose her sexual partners has been attenuated. However, in the latter part of the 20th century, for some communities there was a lessening of the cultural mandates for an on-going social father and a permanent marriage commitment; i.e., procuring a divorce became relatively easy and was de-stigmatized. The resulting divorce patterns in the these communities, it is argued, reflect a much older mating pattern wherein female choice, based upon her psycho-emotional motivations, may have been pre-potent in selecting mating partners.

Key Words: Marriage; Divorce; Cultural evolution; Human evolution; Father-child relations.

In exploring the kind of crucible that would result in the current patterns of human reproductive strategies and tactics, Fisher (1983) developed the idea of the "sex contract": to wit, women exchanged (relative) sexual exclusivity with a man for his unique, systematic, and reliable provisioning and protecting of her and their children. Fisher's presentation is both parsimonious and elegant. Fisher's thesis addresses the necessary, if not sufficient, pre-conditions for successive generations to occur: first finding a willing and suitable mating partner, then mating with that partner, and finally rearing the resulting offspring to the offspring's own independence, if not fertility.

This article extends Fisher's thesis to examine the consequences of

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the cultural severance of the contract between the husband and the wife; i.e., divorce.

Finding the Proper Mate and Mating.

Romantic love (limerence) appears to be a cultural universal (Jankowiak,1995; Jankowiak & Fisher, 1992; Tennov, 1979). This often discussed, mulled and pondered emotion brings pairs of men and women together. The pair mates and conceives a child.

Part of the folklore, buttressed by data, is that romantic love is temporary / ephemeral and predictably dissipates over time (see Fisher [1992] for data). After the passions have waned and the child has been weaned, then if the woman were unfettered by cultural constraints she would once again be able to seek the most available and appropriate mate – maybe the same man, but maybe a different one – and would then generate another cycle of romantic love followed by a second birth. Such a system is fairly open for the female and her psycho-emotional predilections, and thereby optimizes or maximizes a selection of an acceptable mating partner with whom to realize the continuance of romantic love and, thus, to also realize the protection and provisioning of a succession of males. Such a reproductive system would maximize the woman's choice of partner.

This maximization of women's choice is in the context of the larger mammalian tendency that the female is the more selective gender in choosing a sexual partner and the gender which expends more energy in gestating and rearing her offspring (buss 1989, 1994, buss & schmitt 1993, cashdan 1993, symons 1979). Accordingly, there is no imperative of gender symmetry in mating tactics. Males, if possible, gravitate towards polygyny in lieu of exchanging mates which would, thereby, restrict the men to monogamy.

Attenuation of the Woman's Sexual Selection

However, with the species' inclusion of a social father – with an independent man-to-child affiliative bond – plus the rise of paternal certainty, countervailing forces had emerged that would act to more cloister the woman. Her choice of mating partner would thereby be constricted by bio-cultural constraints. That is, as our ancestors glided from pre-cultural to proto-cultural to cultural beings, the biological

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behavior of mating/pair-bonding was absorbed into the more symbolic ritual of "marriage". And marriage clearly acts to restrict mating partners.

Marriage

There is a consensus that "marriage" is a cross-cultural universal (Brown, 1991; Levinson & Malone, 1980; Stephens, 1963; Van den Berghe, 1979). Nonetheless, the attempt to construct a definition of marriage that would neatly delineate the diverse, disparate, variegated and polyglot societies around the world has proved vexing to anthropologists. If nothing else, humans are inventive and symbolic creatures. However, a couple of essentials do seem to be universal in the institution of marriage.

(1) Marriage publicly announces and sanctions that the married couple can have sexual relations with each other. Other avenues of sexual adventures may occur, but (a) if two people are "married," then (b) sexual relations would be appropriate. If (a) they are not married, then (b) sexual relations may or may not be appropriate.

(2) Marriage aligns a man with a woman's children. That is, marriage "legitimizes" children (Hartley, 1975; Hendrix, 1996; Malinowski, 1927)

Leach's (1955, p.183) list of features of marriage is a little more structured, but essentially encompasses the same two concepts as above. Leach's list includes the following.

Marriage is:

1. To establish the legal father of a woman's children.
2. To establish the legal mother of a man's children.
3. To give the husband a monopoly in the wife's sexuality.
4. To give the wife a monopoly in the husband's sexuality.
5. To give the husband partial or monopolistic rights to the wife's domestic and other labor services.
6. To give the wife partial or monopolistic rights to the husband's labor services.
7. To give the husband partial or total rights over property belonging or potentially accruing to the wife.

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8. To give the wife partial or total rights over property belonging or potentially accruing to the husband.
9. To establish a joint fund of property – a partnership – for the benefit of the children of the marriage.
10. To establish a socially significant "relationship of affinity" between the husband and his wife's brothers.

Not all societies follow each of these ten items with equal faithfulness; however, items #1, #3, and #6 have a wide following, indeed.

For the societies that we know about (from Divale & Harris, 1976):

(a) All societies allow monogamy. About 15% allow only monogamy.

(b) Most (85%) societies allow polygyny. Nearly half (48%) allow general polygyny, and approximately a third (36%) allow limited polygyny. It should be noted that, even where polygyny is allowed – because women are expensive – most married men live in a monogamous relationship; e.g., the Dobe !Kung (Lee, 1982). Generally, extramarital sexual activity is non-approved, although reinforcing sanctions range from the very slight to the very severe (Broude, 1980; Broude & Greene, 1976; Schlegel, 1972; cf Mackey & Immerman [2001] for a discussion of [only apparent] exceptions).

As has been well publicized, sexual restrictions are not gender neutral. Men are generally allowed greater sexual latitude than are women. The greater latitude is more salient when married men are compared to married women.

Hence, compared to our nearest homologues, the (female) chimpanzees and the (female) bonobos, women are expected to have a more constricted number of approved or appropriate sexual partners; or, framed slightly differently, societal expectations include attenuated choices in the woman's selection of sexual partners.

Divorce

Of course, to provide for the possibility that a man or a woman were to renege on his/her clause of the basic sex contract, most societies have constructed channels that allow the marriage to be terminated; i.e. a sanctioned divorce. As Fisher anticipated, socially sanctioned reasons for divorce are asymmetrical by gender: to wit, cultural traditions were constructed such that a lack of sexual activity/fertility on the part of his

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wife allows a man to petition for divorce, and lack of resources and lack of physical protection on the part of the husband allow a woman to petition for divorce. See Table 1. See Betzig (1989) for a more detailed catalogue. With the execution of a socially publicized and accepted divorce, the spectrum of mating partners, i.e. marriage partners, is again increased for each of the partners.

Accordingly, up to the middle of the twentieth century, Fisher's sex contract was predictive of the known on-going societies: a man would uniquely protect and provision his wives/children in exchange for (relative) sexual exclusivity of the part of the woman. Cultural expectations were ensconced that would help to adhere the same man to the woman-child dyad beyond the longevity of romantic love; i.e., across a succession of the man's own children. Thus, in the trade-offs between individual freedom and community viability, the woman's freedom to select her sexual partner was curtailed in exchange for the advantages offered by an on-going social – as well as biological – father in the rearing of the community's children. However, by the mid-twentieth century, a new social ecology for human reproductive pattern had emerged.

Cultural Changes in the Mid-Twentieth Century

In the mid-twentieth century, several cultural changes occurred in some areas of the world, notably in Western Europe and its extensions; e.g., the U.S., Canada and Australia: (i) relatively inexpensive and relatively effective contraceptive techniques, under the control of the woman, became available; (ii) no-fault divorce or its equivalent became a norm; (iii) governmental social service programs minimized privation on the part of children – independent of their parental situations – ; (iv) an increased access of females into the paid labor force gained momentum; and (v) the social evaluation of the mandate for a social father was lessened. It is argued here that these cultural changes affected the reproductive dynamics of the referent communities.

One consequence of these changes is that the traditional husband/father – as protector and provisioner – is less crucial for the survival of the woman-child dyad. The local police forces and a cash economy are clearly competitors of the traditional husband/father role.

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Hence, if protection were proffered by a professional police force and if either the woman (in the paid labor force) or the government's social services offices generated resources, then a husband would no longer be as vital for the woman to successfully rear her offspring to independence.

Within the context of the recent shift in social structure, the question can be asked: "What further shifts, if any, occurred in patterns, especially by gender, in the filing or petitioning for a divorce (the termination of a marriage)?"

Parameters of Divorce across Cultures

Divorce Rates: Cross-Cultural

From the United Nation's data, a sample of 92 countries with available statistics had a mean divorce rate of 1.6 (sd. = 1.1) per 1,000 population with a range of 0.1 to 4.3. (United Nations 2001). As a matter of context, the current U.S. divorce rate is 4.0 (U.S. Bureau of the Census, 2002). It is useful to note that the gender of the petitioner is rarely included. It should also be noted that the sample of 92 nations that had data for divorce is not totally representative of the available nations. Sub-Saharan Africa is under-represented, and Europe is over-represented. Thus, the *caveat* of non-randomness is appropriate here.

Divorce and Social Context

– Intelligence Agency, 2003). The data indicate that divorce rates are (negatively) related to the annual percent of natural increase. The correlation is fairly robust (r_p = – .487; p < .001; n = 92 nations). Over 20% (.487^2 = .237 = 23.7%) of the differences in divorce rates can be attributed to differences in percentage of natural increase. Framed a little differently, as rates of natural increase become lower and, thereby, fewer years of the woman's life are needed to be devoted to child-rearing, divorce rates become higher. Despite the coarseness of using a nation as a unit of analysis with the increased risks of false negatives, the shifts are somewhat substantial.

– Divorce rates: a model

Of course, neither divorce rates nor levels of natural increase occur in isolation, and additional variables need to be assayed to flesh out a context. The following model is offered to give the divorce-and-natural

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increase relationship just such a context. The following data were gleaned from information provided by the United Nations (United Nations 2001) and the Central Intelligence Agency (2003).

A number of authors have noted that when a country develops a cash economy workers are needed to man stores, factories, and businesses. If women are allowed access to those newly-created jobs, they quickly integrate themselves into the paid labor force. For discussion and examples, see Bulatao, et al. (1983), Caldwell (1982), Day & Mackey (1986), Easterlin & Crimmins (1985), Fawcett (1983), Handwerker (1986), cf. Aghajanian (1977, 1988), Bradley (1984), Nag, White & Peet (1978), Ross & Harris (1987). Thus, the model would suggest that as an expanding cash economy (indexed by the gross domestic product's per capita income) gains momentum in a country, then (i) the percentage of the labor force engaged in subsistence agriculture will drop, (ii) birth rates will drop (and, as a consequence, rates of natural increase will drop [as long as death rates do not decrease]), and (iii) the percentage of females who are in the national parliament – a marker for women's autonomy – will increase. As the data in Figure 1 indicate, such is the case. (Note that all indices were not available for all countries; hence the "n" varies per index). In addition, if total fertility rate (TFR; the total number of children a woman is expected to bear during her lifetime) replaces rate of natural increase as a marker for population change, then the (patterned) results remain the same. See Appendix I.

Furthermore, as subsistence agriculture lessens in importance, divorce rates tend to increase ($r_p = -.462$ $p < .001$, $n = 91$). As the percentage of women in national parliaments increases, so does the divorce rates ($r_p = .350$; $p < .001$; $n = 89$). The combined effect upon divorce rates of the four variables (natural increase, percentage of females in the national parliament, per capita income, and the percentage of the labor force in agriculture) is significant ($R = .642$; $p < .001$; $n = 88$) and accounts for more than a third (adj. $R^2 = 38.4\%$) of the variance in divorce rates. See Figure 2.

Synopsis

From these data, the following argument is made. When women,

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within their own socio-cultural milieu, can expand their status-role complexes beyond that of motherhood, they will do so. That is, women tend to gravitate toward greater life choices or options rather than less. If the women can enter into the paid labor force and earn a salary, they will do so. If alternative status-role complexes, other than motherhood, are adopted by women, then the number of births per woman decreases. Birth rates drop, and the annual percentage of natural increase also drops. If the traditional male role of breadwinner can now be performed by the woman herself or by governmental agencies, then the husband/father, if he proves unsatisfactory to the woman, can be jettisoned by divorce (if divorce is allowed in the country or community in question and if she is pre-emptively given child custody).

Europe versus the Moslem Swathe

Let us take two polar sub-samples and carry out the analysis just with the two sub-samples. The two sub-samples are Europe (n = 36 countries) and a swathe of countries wherein Islam is the dominant religion starting from Mauritania and running eastward to Pakistan (n = 25 countries). These sub-samples abut each other around the Mediterranean Sea: the Moslem swathe to the south and Europe to the north.

For example, the Moslem swathe – compared to the European nations – had (i) a higher level of natural increase, (ii) a lower percentage of females – rather than males – in national parliaments, (iii) a higher percentage of the labor force engaged in agriculture, and (iv) a lower GDP per capita income, See Table 2.

The Moslem Swathe and Divorce

Authors who have written ethnographic accounts of the relevant Moslem countries invariably refer to the strongly patriarchal character of the political and economic structures. The question is never "*Is* the country patriarchic?" The theses revolve around how the patriarchy developed and how is it maintained. For example, Ahmed (1992) writes: The subordination of women in the ancient Middle East appears to have become institutionalized with the rise of urban societies and with the rise of the archaic state in particular..." and, as Islam crystallized its theology, Implicit in this new order was the male right to control women and to interdict their interactions with other men. Thus the ground was

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prepared for the closures that would follow." See Kadioglu (1994) for a parallel argument for women's role in Turkey. Toubia (1988, pp. 2-3) makes the case quite clearly: "Arab women are dominated by men in every area of life in the patriarchal family system: state, political party, trade union and public and private institutions of all types." She noted that over 97% (97.2%) of the Yemeni women, as late as 1975, were illiterate. Badran (1995, p. 5) notes that "the woman was perceived as essentially or exclusively, a sexual being, unlike the man who was only partly understood in terms of his sexuality". Gerami (1996, p. 157.) views the current version of Islamic fundamentalism as "...nipping a very young feminist movement in the bud and under the banner of nature's mandate, pushed women further into the family. They managed to cast woman's individualistic identity as a perversion of her nature plotted by Western imperialists". Obermeyer (1995, p. 370) observes that the "Islamic emphasis on complementarity rather than equality in gender roles" makes dialogue with a worldview predicated on equality rather than complementarity extremely difficult. Inhorn (1996) writes that: "In a society (Egypt) where the patriarchal fertility mandate is emphatic, the social and psychological consequences of 'missing motherhood' – of being a woman unable to deliver a child for her husband, family, affines, community, faith, nation, and not inconsequentially her – are nothing if not profound".

It is germane to this argument that, in general, Moslem men can initiate divorce far more easily than Moslem women. The Koran gives some theological basis for this asymmetry, and local interpretations have intensified the gender differences (Ansari 1973, Caner & Caner 2002, Hekmat 1997, Kamali 1984), (cf Barlas [2002] who specifically argues that the interpretations of the Qur'an, rather than the Qur'an itself, result in high levels of patriarchy). For reviews of the literature, see Al-Qazzaz (1977), Meghdessian (1980), Mernisse (1991), Raccagni (1978), and Tucker (1993). For theoretical overviews, see Caner & Caner (2002), Lerner (1986), Orens (2003), and Walby (1990).

For the surveyed nations with available data, the divorce rates in European countries (mean = 2.0; sd = 1.0) were higher than divorce rates in the Moslem swathe (mean = 0.9; sd = 0.4) ($t = 12.6$, $p < .001$; $df = 44$). This result is consonant with the thesis presented here. To wit:

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if women are given greater opportunity to petition for divorce, they will avail themselves of that opportunity. Thereby, the divorce rates will increase. European wives have more options, and Europe has a higher divorce rate. Wives in the Moslem swathe have fewer options, and the Moslem swathe has a lower divorce rate. See Table 2.

Presence of Children and Divorce

Statistics on the presence of children in divorces are not plentiful. However, some nations do supply that information. For example, in 1986, 46% of the divorces in Turkey were childless (State Institute of Statistics, 1999). In 1994, in Morocco, 50% of the divorces were childless (Bourqia, 1994). In 2000, in Norway, 42% of the divorces were childless (Statistics Norway, 2000). In 1990, in England and Wales, 45% of the divorces were childless (Registrar General, 2002). In 1990, in the U.S., 47% of the divorces were childless (National Center for Health Statistics, 1996). Accordingly, there is some evidence that a plurality of divorces are childless – over-represented in the data – and do not dissolve a traditional nuclear family. In the context of such divorces, both ex-spouses are made free to find other sexual partnerships, some of which may be more fecund. Because there are no children involved in the divorce, no disadvantages would be experienced by any children as a consequence of a lack of the social father.

Gender Asymmetry: a Quantitative Analysis

Again, statistics on the gender of petitioner are not plentiful. However, data were available from the U.S., the United Kingdom, and Ireland. For this restricted sub-sample of the U.S., England and Wales, Ireland, and Northern Ireland, wives dominated petitioning for divorce. See Table 3. The ratios of wife-to-husband petitioning ranged from 1.7 to 2.5. (See the *Beijing Review* [1995], Buckle et al. [1995], Dennis [1992], Hong & Ning [1992], Peters [1979], and Sullivan & Allen]1996] for analogous, if not equivalent, data from other countries).

The U.S. Example

In the U.S., wives' domination of divorce petitionings occurs across virtually all categories (National Center for Health Statistics, 1989, 1996; see Chadwick & Heaton [1992] for discussion). If children (1 or more)

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are involved in the U.S. divorce situation, then the women dominate in petitioning by more than a two to one ratio. The range is from 2.3 – 2.4 as a function of the number of children. See Table 4. It may be useful to note that the majority (51%) of the husbands' petitionings occur when there are no minor children involved, whereas the majority (58%) of the wives' petitionings occur when at least one minor child is involved in the marriage.

Gender Asymmetry: a Qualitative Analysis

In the U.S. (see Table 5) and Australia (see Table 6), divorced individuals were queried on the initiation of the divorce proceedings. For both the U.S. and Australian samples, both the men and the women agreed that it was the wives who more wanted to initiate the divorce proceedings.

Wives' Reasons for Petitioning for Divorce

Several studies surveyed divorced women in order to determine the (stated) reasons for their petitioning: U.S., Australia, China. See Table 7. Although reasons that would indicate a danger from the husband/father to the wife or to the children are mentioned (e.g., physical violence, financial privation, drug/alcohol abuse), the primary reasons more reflected the woman's psycho-emotional condition;,e.g., unfulfilled, lack of love, drifted apart. Although the women deemed themselves unhappy, they did not view themselves in physical danger.

The next section focuses on more finely-grained divorce patterns over time in the United States.

Divorce in the U.S.: An Exemplar

U.S. Divorce Over Time

With the exception of a few years immediately after World War II, the divorce rate in the U.S. was less than 2.0 (per 1,000 population) until the late 1960s. By the 1980s, the divorce rate had climbed to the low 5's, and has (at least temporarily) stabilized in the low to middle 4's (Bureau of the Census 1920 – 2003).

As mentioned earlier, the percent of divorces that included no minor children has consistently stayed above 40%.

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U.S. Divorce and Child Custody

Until the 1990s, the U.S. kept fairly complete records of divorce with gender-petitioner cross-indexed with number of minor children involved in the divorce. Despite judicial pronouncements of gender equality in custody decisions (Cornick 1995, McIntyre & Sussman 1995, Westfall 1994, Weyrauch & Katz 1983), the *de facto* reality is a strong bias toward awarding child custody to the mother. For example, in a sample of 19 reporting states, custody in 72 percent of the cases was awarded to the wife, and 9 percent was awarded to the husband. Joint custody was awarded in 16 percent of the cases (Clark, 1995). This distribution seems to be fairly consistent (Clark, 1995). More localized studies also found a similar breakdown that favored the mother versus the father (Sheets & Braver 1993; Maccoby & Mnookin 1992). In some jurisdictions, mothers gained custody in 90% of the divorce cases (Fox & Kelly, 1995; Sack, 1987; Sitarz, 1990). In 2000, the same percentage of minor children who were living with neither parent (4%) were living solely with the father (4%). Twenty-three percent of the minor children were living soley with the mother, and 69% lived with both parents (U.S. Bureau of the Census 2002).

As a matter of contrast, when the U.S. population was mostly composed of rural farming communities, the father – owner of the farm – would retain custody of the child, and the ex-wife would leave the farm and her children (Mnookin, 1975; Zelizer 1985). Urbanization shifted the presumption of custody rather dramatically.

Conclusion

Based on the available data, which are clearly preliminary rather than determinative, the following scenario can be constructed which is consonant with Fisher's thesis. When increased opportunities to initiate divorce are opened up for wives, the wives avail themselves of the increased opportunities. The pre-potency of the psychological and emotional reasons that are volunteered by the women supports Fisher. It is clear that an emotion, any emotion, is not going to exist – at all – unless there is a neuro-hormonal base that also exists to create it. Similarly, no neural system and no hormonal system are going to exist – at all – unless genetic material acts as a blueprint or a recipe to direct

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their construction. Such genetic material is continuously subjected to the pressures of natural selection.

Thus, if the societal expectations do allow, but do not stigmatize, divorce, and, if the woman normally retains custody of her minor children, then women energize themselves to dominate divorce petitioning. Framed a little differently, it is argued here that a reproductive system has recently (re)appeared that putatively mirrors a much older, perhaps pre-cultural system: a system that enhances female choice in the selection of mating partner, but tends to preclude the on-going presence of a social and biological father.

The divorce clause in Fisher's sex contract has been extended, according to the additional data that have been provided above: to wit: if the cultural traditions and sanctions, which otherwise adhere spouses to each other, are removed, then wives – more so than husbands – will be motivated to avail themselves of the opportunity to replace their current sexual partners. The absence of children probably make the dissolution less complicated. To the extent that U.S. women may be representative of women at large, then it may be said that women, in assigning priorities, evaluate their motivations for increased independence and enhanced options as higher than the advantages accrued to their children by the presence of an on-going biological and social father.[2]

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[2] A number of studies have shown that fatherless children (e.g., born out-of-wedlock) are more prone to deviant behaviors, including violent crime (Adams, Milner & Schrepf, 1984; Anderson, 1968; Bereczkei & Csanaky, 1996; Blau & Blau, 1982; Chilton & Markle, 1972; Monahan, 1972; Mosher, 1969; Robins & Hill, 1966; Stevenson & Black, 1988). See Mischel [1961a, 1961b) and Mackey (1985, 1996) for theoretical orientations to the suggested linkage. See Adams, Milner & Schrepf (1984), Amato & Booth (1997), Wilson & Herrnstein (1985), Draper & Harpending (1982), Blankenhorn (1995) Popenoe (1996), and Parke & Brott (1999) for reviews of the literature. For a son, the absence of an on-going social and biological father in his early childhood is associated with increased tendencies toward violent crime after puberty (Mackey & Mackey, 2003; Mackey & Coney, 2000; Mackey & Immerman, 2000). For daughters, (in the U.S.) out-of-wedlock births in a prior generation are strongly correlated to rates of Sexually Transmitted Diseases (STDs) in the subsequent generation (Mackey & Coney, 1997, 2000). Because multiple sexual partnerships is the best marker or predictor for contracting an STD, it is suggested that the absence of a social and biological father early in a daughter's life creates a change in her reproductive tendencies after puberty.

In addition, because single mothers tend not to remain chaste, the mothers will form alliances with adjunct boy-friends. These men, who are not the biological and social fathers of the mothers' children, place the children at an increased risk of serious child abuse (Daly &

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The argument made here – in the context of rather incomplete data – is that when the mandates of the cultural overlay of marriage are lifted, then the more ancient motivations of pair-bonding become prepotent: (i) romantic love generates sexual partnerships which result in progeny, (ii) over time, romantic love between the partners dissipates, (iii) romantic love is then re-generated with new potential partners, and (iv) the cycle continues. It is worth repeating that no emotion is going to exist – at all – unless there is an existing neuro-hormonal base to create it. Similarly, no neural system and no hormonal system are going to exist – at all – unless genetic material acts as a blueprint or a recipe to direct their construction. In turn, the current, extant genetic mosaics must be survivors of past (natural) selection in which – across countless generations – they reproductively out-competed alternative variants.

The bio-cultural trade-offs are basic and probably eternal: more freedom and choices of the individual woman in selecting her preferred sexual partnerships are weighed against the benefits by her community in maintaining the status-role complex of the social father. In essence, an experiment has been inadvertently forged as to where the balance of the two forces may eventuate or finalize. The adjudication of that shifting balance point will become determined only across generations as evidenced by the social structure and by the cultural traditions of the extant communities.

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Table 1.
Culturally accepted causes of divorce across societies (adapted from Betzig 1989)

Behavior leading to divorce	*Number of societies with reported data*	*Spouse viewed as culpable:* *Husband*	*Wife*	*Both*
Indices of infidelity or infertility	185	17	120 *	48
Economics	50	49 *	0	1
Cruelty or maltreatment	51	46 *	0	5

* More likely to be viewed as the more culpable spouse:
Husband versus Wife (c^2 = 172.4; df = 2; $p < .001$; f = .78.

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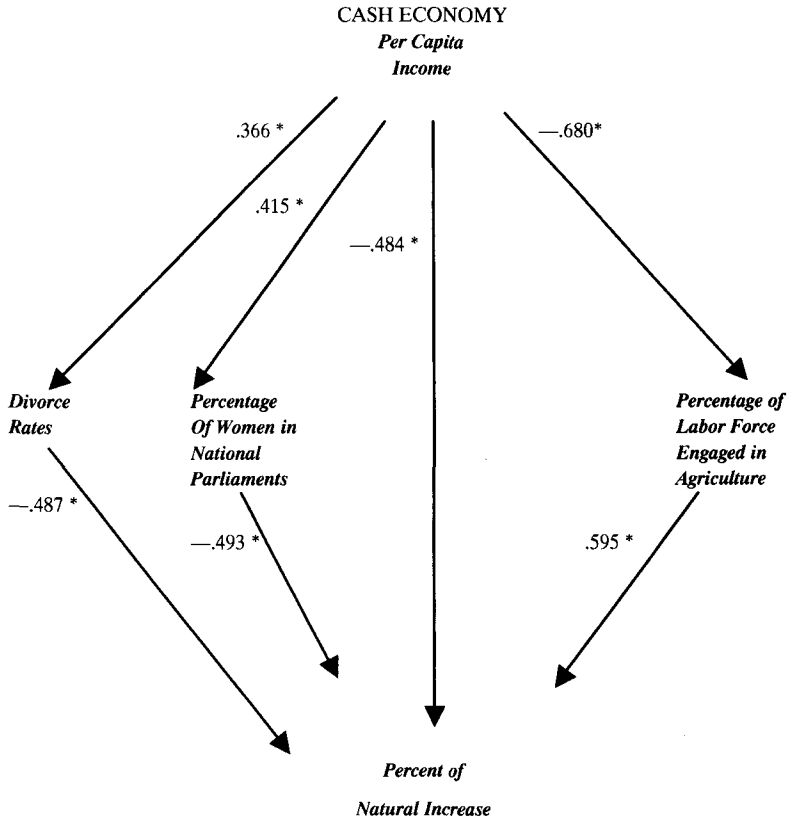

R = .604; p < .001; n = 88

Adj. R^2 = .334 = 33.4%

* p < .001 (n's range from 92 to 171)

Figure 1.
Demographic Parameters to Natural Increase

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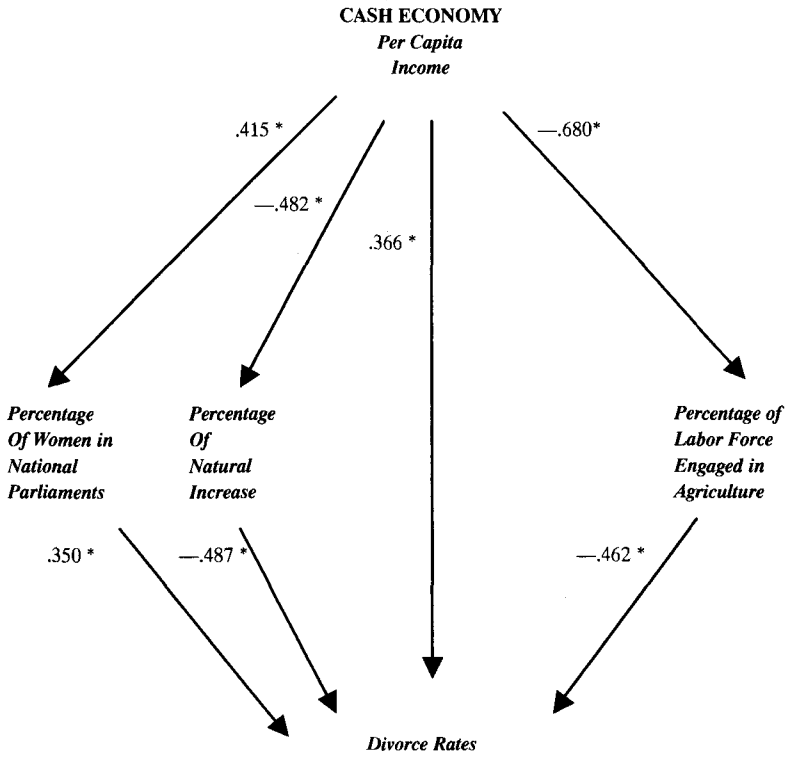

R = .642; $p < .001$; n = 88

Adj. R^2 = .384 = 38.4%

$p < .001$ (n's range from 89 to 171)

Figure 2.
Demographic Parameters to Divorce Rates

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Table 2.
Countries in Europe (n =36)
versus countries in a Moslem swathe (n = 25)
along five demographic indices (Central Intelligence Agency 2002, United Nations 2001).

Index/n	*European*		*Moslem swathe*		*t.*
	Mean	*s.d.*	*Mean*	*s.d.*	
Percent annual rate of natural increase/ n = 61	0.2	0.5	2.4	1.1	152.7**
Percent of females in national Parliaments/ n = 61	17.7	10.6	3.0	3.7	43.9**
Percent of labor force in agriculture/ n = 61	12.5	11.8	35.0	24.8	22.5**
GDP per capita income (in dollars)/ n = 61	12,102.2	7,669.4	5,986.8	6,442.4	8.6*
Divorce rates / n = 46	2.0	1.0	0.9	0.4	12.6**

*** p < .01; ** p < .001**

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Table 3.

Locality/(Year)[a]	*Percentage of Petitions:*		*Ratio of*
	By Wife	*By Husband*	*Wife/Husband*
Ireland (2001)	61.1%	38.9%	1.70
England & Wales (2000)[b]	69.7%	30.1%	2.32
Northern Ireland (1999)	71.7%	28.3%	2.53
U.S./(1986)[c]	61.5%	32.6%	1.89

[a] Sources:

Ireland (*Family Law Information Bulletin*, 2001)
England & Wales (Registrar General, 2002)
Northern Ireland (Office of National Statistics, 2000)
U.S (National Center for Health Statistics, 1989)

[b] Other: 0.2%
[c] Other: 5.9%

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Table 4.
Percentage of divorces in the U.S., by number of children and by status of petitioner: 1982-1986 (Mean number of divorces = 573,931) (National Center for Health Statistics 1989).

Number of children		*Status of petitioner: Wife*	*Husband*	*Other*	*Total*	*Ratio: Wife/Husband*
None		55.9%	35.5%	5.6%	100.0%	1.57
	sd	0.9	0.3	1.2		
One		64.8%	27.8%	7.4%	100.0%	2.33
	sd	1.0	0.1	0.5		
Two		64.7%	27.6%	7.7%	100.0%	2.33
	sd	0.7	0.7	0.6		
Three or more		65.7%	27.4%	6.9%	100.0%	2.40
	sd	0.7	0.8	0.6		
All children		60.2%	31.3%	8.5%	100.0%	1.93
	sd	0.8	0.4	0.5		

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Table 5.
Perceptions of who wanted the marriage to end by gender of spouse (from the National Survey of Families and Households [Chadwick & Heaton 1992])

	Perception Of How The Marriage Ended By Divorce:					
Spouse responding	Husband wanted divorce; Wife didn't.	*Husband wanted divorce more.*	Both spouses wanted divorce.	*Wife wanted divorce more.*	Wife wanted divorce; Husband didn't.	*Other*
	1	***2***	**3**	***4***	**5**	***6***
Husband	9.4%	8.7%	35.8%	15.9%	18.7%	11.5%
Wife	8.1%	9.3%	23.7%	20.0%	29.6%	9.3%
Difference	1.3%	— 0.6%	12.1%	— 4.1%	— 10.9%	

Husband	(1) + (2) = 18.1%	Husband	(4) + (5) = 34.6%
Wife	(1) + (2) = 17.4%	Wife	(4) + (5) = 49.6%

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Table 6.
Who initiated the separation:
Wives' reports and Husbands' reports (Wolcott & Hughes, 1999)

	Mostly Wife	*We Both Did*	*Mostly Husband*	*Total*
Wives' reports:	64%	16%	20%	99%[a]
Husbands' reports:	53%	26%	21%	100%
Difference:	11%	—10%	—1%	

[a] 1%; not answered

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Table 7.
Most important reasons that women gave for petitioning for divorce (by rank and by percentage of women who "checked" the reason for the divorce) for ten surveys.

	SURVEY, RANK, REASONS AND PERCENTAGE			
	Cleek & Pearson (1985)		*Burns (1984)*	
Rank	Reasons	Percentage	Reasons	Percentage
1	Lack of communication	69.7%	Husband not home enough	46%
2	Wife is unhappy	59.9%	Lack of communication	40%
3	Incompatibility	55.5%	Sexual problems	40%
4	Emotional abuse	32.9%	Other women	37%
5	Financial problems	32.9%	Financial problems	36%
6	Sexual problems	32.1%	Spouse's drinking	36%
7	Spouse's drinking	30.0%	Wife's lack of interest	26%
8	Infidelity of spouse	25.3%	Husband's cruelty	21%
9	Physical abuse	21.7%	In-laws/relatives	21%
10	In-laws/relatives	10.7%	Disagreement over children	19%

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Table 7 (Cont.)

SURVEY, RANK, REASONS AND PERCENTAGE

Rank	*Gigy & Kelly (1992)* Reasons	Percentage	*Wolcott & Hughes (1999)* Reasons	Percentage
1	Growing apart	78%	Communication problems	22.6%
2	Feeling unloved	73%	Affair: spouse/self	20.3%
3	Sexual problems	64%	Incompatibility/drifted apart	19.8%
4	Unmet needs	64%	Alcohol/drug abuse	11.3%
5	Differing values	63%	Physical violence	9.6%
6	Feeling belittled	59%	Physical/mental health	4.2%
7	Spouse's emotional	52%	Financial problems problems	4.0%
8	Financial problems	50%	Emotional/verbal abuse	2.5%
9	Conflict over gender roles	47%	Children problems	2.0%
10	Fighting	44%	Work/time	1.7%

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Table 7 (Cont.)

SURVEY, RANK, REASONS AND PERCENTAGE

Rank	*Mao (2000)* Reasons	Percentage	*W Braver (1998)* Reasons	Percentage
1	Third party involvement	74%	Gradual growing apart, losing a sense of closeness	57%
2	Lack of emotional exchange	66%	Serious differences in lifestyle and/or values	54%
3	Intolerable personality	59%	Not feeling loved or appreciated by spouse	45%
4	Extreme unhappiness in family life	56%	Spouse not able or willing to meet major needs	41%
5	Distrust	46%	Emotional problems of spouse	38%
6	The time of living together is too short	46%	Husband's extramarital affair	37%
7	Problems in having sex fighting, frequent conflict	20%	Severe and intense	36%
8	Frequently felt put down or belittled by spouse	35%		
9	Spouse not reliable	33%		
10	Problems and conflict with roles i.e. division of responsibility for household jobs or other chores outside of house.	29%		

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Table 7 (Cont.)

SURVEY, RANK, REASONS AND PERCENTAGE

	Thurnher et al. (1983) Divorces involving one or more minor children		*Thurnher et al. (1983)* Divorces involving no minor children	
Rank	Reasons	Percentage	Reasons	Percentage
1	Spouse's drinking	18.8%	Conflict in lifestyles	24.0%
2	Spouse has changed	17.0%	Idiosyncratic	19.5%
3	Spouse is violent	16.5%	Financial reasons	17.1%
4	Strife	16.1%	Wife wants increased freedom	15.9%
5	Idiosyncratic	16.0%	Spouse is indifferent	13.4%
6	Conflicts over lifestyles	15.4%	Sexual problems	13.4%
7	Souse is demeaning	15.3%	Spouse has changed	12.2%
8	Spouse runs around	14.9%	Spouse is violent	11.0%
9.5	Financial problems	13.6%	Spouse runs around	9.8%
9.5	Sexual problems	13.6%	Lack of communication	9.8%

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Table 7 (Cont.)

SURVEY, RANK, REASONS AND PERCENTAGE

Complaint	*Levinger (1966)* *Percentage Of Women Making The Complaint*					
	Rank	*All Women Women*	*Rank*	*Middle-Class Women*	*Rank*	*Working--Class*
Mental cruelty	1	40.3%	2	37.2%	1	40.8%
Neglect of home or children	2	39.0%	1	45.7	4	37.4%
Physical abuse	3	36.8%	5	22.8%	3	40.1% *
Financial problems	3	36.8%	6	21.9%	2	40.2% *
Drinking	5	26.5%	8	14.3%	5	29.4% *
Verbal abuse	6	23.8%	7	20.0%	6	24.5%
Lack of love	7	22.8%	3	34.2%	8	20.6% *
Infidelity	8	20.0%	3	34.2%%	7	22.3%
Sexual incompatibility	9	13.8%	9	12.4%	9	14.1%
In-law trouble	10	6.7%	—	—	10	7.4%

* $p < .01$; difference between middle-class women and working-class women

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Table 7 (Cont.)

SURVEY, RANK, REASONS AND PERCENTAGE

Rank	*Greif & Pabst (1988)* Reasons	Percentage
1	Marital incompatibility	46.2%
2	Husband was unfaithful	23.4%
3	Husband had emotional problems	10.1%
4	Mentally abused	9.1%
5	Physically abused	8.9%
6	Husband left	5.6%
7	Had affair/wanted to leave	4.9%
8	Own emotional problems	3.7%
9	Husband immature	2.5%

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China – Emerging Hegemony
A Speculative Essay

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The author argues that China, considering its geo-political situation, its extensive control over the water resources of south and southeast Asia, and relatively high intelligence and educability of its population will emerge as the dominant world power by the middle of the 21st Century. An important dimension of its international influence will derive from the fact that as a nation with a population estimated to approach possibly 1.8 billion, its highly educable and hardworking people will be able to out-produce the rest of the world at salaries unacceptable to the West. The author suggests that its power will create a new Asian hegemonic association of states, possibly including even Korea and Japan. Only internal instability can prevent it from attaining world dominance by the late 21st century.

Key Words: Intelligence; Demography; Asian water resources; Wage structure; Ethnic profile; Geo-economic viability; Socio-political stability

Mainland China is becoming a major player on the world economic and political scene. But how much of a threat? That is the proverbial $64 million question. Most of the commentators look at Japan's and South Korea's surge over the past forty years. They posed an economic challenge, yes, but then came the inner antinomies that development reveals, and with them these two nations experienced a swathe of new problems. They became big players; but the U.S. once more showed its ability to prevail on the international economic, political, and military scene. The Soviet and Maoist solution similarly became a part of the graveyard of ideological presumptions. Even Western Europe and the EU seem moribund, paralyzed by their history and adopted ideology.

But the Chinese challenge to the U.S. is real; it is wholly different than those other post-W.W.II surges against U.S. hegemony on the world scene. The nature of the Chinese thrust will spell itself out in new geo-political alliances and power balances In the opinion of many commentators that China will have become the predominant super-power on the planet by 2050, while, by contrast, the U.S. could be

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stagnating.

Whistling in the Dark

Optimists are indeed uncomfortable as they look to the Far East, but they still find excuses to retain their optimism in the face of possible Chinese world hegemony. China is surging for the moment, some argue, but Japan, Korea, and Mexico also grew at spectacular rates for a while. Indeed, Japan soared for over thirty years. South Korea, after a hiccup several years ago, is still on the move. China has 1.3 billion people, Japan, 128 million. Much of the temporary concern addresses itself to the trade surpluses that China and the other Northeast Asian nations are currently accumulating, while the U.S. has vast trade deficits, ameliorated only by the investment of these trade surplus nations in the U.S. bond and stock markets. These nations are also buying U.S. currency with this surplus: Japan $453 billion; China $257 billion; South Korea $117 billion. Japan may be sick, with vast internal debts held by their nearly insolvent banks, but it still has lots of cash in the governmental coffers, and vast private/personal savings to survive their current doldrums.

The Chinese economy while growing rapidly, at circa 9 percent per year, is still only 3.5 percent of global GDP, as compared with the 20 percent held by the U.S. The U.S. economy shows real signs of being a mature economy, slowing down in growth, and losing much of its manufacturing base to Asia. The Maquiladora/NAFTA explosion of investment in Mexico is also shrinking, as many of these factories leave Mexico for China's highly educable work force and rock bottom wages. Dell and other computer makers have seen their Taiwanese suppliers move to the mainland, where about 35 percent of Taiwanese companies lap tops are now assembled. Intel and Microsoft and all the rest of U.S. high tech manufacturing infrastructure is pouring into China.[2]

Automobile manufacturers around the world are also setting up, seeing China not merely as supplier to the world, but a huge market as

[2] Enlightening footnote: The Galesburg Illinois Maytag factory is to close, leaving 1500 U.S. workers without jobs after years of loyal service. The factory will move to Mexico, where instead of paying about $15. per hour in U.S. wages, they will be better able to compete on the world market by paying Mexican workers $2. per hour. The Chinese level of recompense is only $1. per hour, or even less. How long in Mexico, Maytag?

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well. The Chinese are addressing their urban auto congestion, as in Shanghai, are working on Beijing and other cities, all the while building at a furious pace, a nationwide system of toll super highways resembling the U. S. system.

Still, with 1.3 billion people, hundreds of millions unemployed or under employed in the urban as well as rural areas, China is potentially unstable. Its political system is autocratic and corrupt. There is intellectual ferment as the government still attempts to control information, especially sensitive to the internet. Even with their current rate of growth and development they are far from being out of the woods. The per capita income of the Chinese is about $1000 per year, and there is enormous inequality between urban and rural incomes, as well as new class divisions, with millionaires and billionaires now welcomed into the party apparatus. Is class warfare, *a la* "landlords" of Mao's genocidal efforts, that far away for the party in power?

The Western multinational industrial investment in China is huge, over $50 billion in 2002 alone. But the profits are immense. And in a blink, if things get rough in China, the internationals can be out of there in a flash, hopefully carrying their investment capital with them to more peaceful and opportune locales. Internal Chinese industrial/technological replacement corporations will still need the goodwill of the U.S. for exports in order to finance their expansion. Thus, the West, through the WTO and the UN, still has some leverage in controlling undue aggressive behavior by the Chinese.

In short, the optimists argue that the internal problems of China, as it expands from 1.3 to a possible maximum of 1.8 billion people over the next fifty years, will keep the Chinese from asserting predatory superpower status on the international scene. In the long run, they claim, the democratic, free enterprise system that the United States has perfected will ensure the long term protection of America's munificent way of life, as also its leadership of the free world.

Prediction and Policy

The optimistic view would lead America to a policy of, go with the flow. Meaning, that the American way of life, its internal entrepreneurial skills and political sensibilities will carry it through the ups and

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downs of the various historical challenges, namely, radical Islam for the moment, an expanding China elbowing its way up toward the top, in the longer term.

The Chinese have a tradition of centripetal political concentration. Their expansionary device has always been demographic, migration out beyond the coastline of China, and inland absorption of weaker peoples at the southern frontiers, and more powerful roughnecks from the north. Recall that only for the last several hundred years has China ceased from being the recipient of invasions from peoples from the north, thence to be absorbed into the ever-regenerated Han linguistic, ethnic, and cultural profile.

Another perspective argues that a nation with 1.3 billion people, having now broken most of the mental political chains which first bound it both to a classical cultural tradition, and thence to a Maoist ideological straightjacket, is a wholly new international element. The evidence for this assertion lies in the leap into modernity that this nation has taken in only the past 25 years. If we look deeply into this phenomenon, for we may find a factual uniqueness which augurs an entirely new challenge to the United States and Europe.

What We Are Missing?

Critical to understanding the future of Chinese relations with the West, and China's position in the international nexus, are two factors: A): the geo-economic viability of the national entity. Here population and resources become crucial for the future. B): the questionable social-political stability of China as it flirts with free market economics, and frees its educational and communication systems to face the new communications technology. Then, class structure, the social integration of the various parts of China, urban and rural, and its ability to satisfy the material and intellectual needs of the people, will become key factors.

(A) Geo-economic Viability

A comparison of contemporary population densities per square mile is a first useful step in our analysis. Russia = 22; United States = 79; China = 354; Italy = 509; Germany = 615; United Kingdom = 640; Japan = 867; India = 898.

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The population of China is still increasing at a rate close to 1%, per year. India's increase is currently about 2% per year. Japan's is close to stasis, while Germany and Italy, close to stasis, suffer from massive legal and illegal immigration, as does the United States, with an approximate .5% rate of internal increase, itself the result of immigration and a high birthrate amongst immigrants. The probability is that as China seeks to further restrict the larger family allocations for its approximate 6-10% non-Han population in the southwest as well as the north, their rate of population increase will further decrease.

The argument that China will suffer significant resource and pollution pressures as the standard of living rises is of course real. On the other hand, the government has a close handle on tax and other revenues such that it has and will further allocate vast amounts of monies to alleviate the problem of population indigestion.

The Three Gorges dam on the Yangtze will not only create enormous opportunity for the generation of electricity, almost 20% of China's projected needs at the time of the completion of dam and the necessary grids, c.2010-15, but also a vast lake to be part of a water diversion project involving a Grand Canal that will shift water to the north, using the Yellow river system to create millions of acres of new agricultural and urban lands for population diversification.

Other such projects, four to six more dams, are already underway on the upper reaches of the Mekong River, which flows through Cambodia and Vietnam. In fact by the re-occupation of Tibet, and the control of that part of Kashmir which provides significant water flow into the Indus River, China now controls virtually all the water sources of South Asia, to the Red River flowing through Hanoi. For example, the Chinese estimate that half of the flood waters that pour through the Yangtze in the spring and summer originate in Tibet.

We can be assured that of the present re allocation of the approximately two million people that have been displaced by the Three Gorges Dam, many will be given subsidies to settle in Tibet and Xinjiang Province, to create a stronger Han ethnic element there both to stimulate development as well as to calm the possible political turbulence created by non-Han populations in a Han dominated nation.

Water is probably the key to the developmental power to be wit-

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nessed on the international scene. The warming of our planet is going to change many ongoing stabilities. Europe may suffer from increasing floods, and need to allocate huge amounts of monies to control its raging rivers. Other parts of the world may suffer serious water shortages. Imagine the plight of Egypt's 72 million, estimated to grow to 127 million by 2050, were the Sudan and Ethiopia to obtain funds from the international agencies to dam up parts of the White and Blue Nile to alleviate the desiccation of their agriculture resources. Turkey, even now is damming up parts of the sources of the Euphrates river system that flows into Syria and Iraq. Turkey is a "bigger boy", than Syria or Iraq, and will therefore have its way.

China, with this kind of control over the water resources of the region might be able to acquire as geo-economic/political "allies", all of the southern Asiatic nations, including even Pakistan, India, Bangladesh, Thailand, and Vietnam. It is quite possible that even Outer Mongolia, Kazakhistan, and other Central Asian countries ,with their oil and gas resources, might be drawn into an "oil for water" alliance. The Russian-Siberian resource potential could also become a hydrocarbon/water competitive factor.

B) Social-Political Stability

The Chinese have always been an ethnicity in the making. Comprised of three ancient racial templates, primarily Mongoloid but with traces of Australoid and even of Caucasoid, what we call the Han ethnicity after the early common era dynasty has been fashioned out of disparate genetic elements, small numbers of provincial peoples now expanded into a vast continental array.

This is part of an ages-old process of ethnic absorption. One asks what has happened to the Kazakh-like rulers of the three ancient dynasties along the Northwest Yellow frontier, Hsia, Shang, Chu, that created the Chinese national entity. Remember the still Kazakh physiognomy and height (even after 1500 years of absorption of indigenous populations) of the terra-cotta soldiers of the Qin dynasty, c. 300-200 BCE. Then the constant eruption of northern Tatars, Huns, Tungus, Luao, Mongols, Hakkas, Manchus pouring into the southern provinces to create an ever more modern Chinese ethnicity, is reflective

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an ever dynamic Chinese population structure, all the while maintaining the inner integrity and fabric of a unique Chinese cultural entity.

Into this mix, the Tibetans and other formerly Austronesian-speaking, Vietnam, Cambodia, Lau-like peoples of the southern frontier, may likely be eventually absorbed. The problems of maintaining social stability in political states that have large minority populations of either superior or inferior educational and socio-economic achievement traditions, will likely not impact on the future of China as it will on the United States, and now Western Europe. Unlike Singapore, neither mainland China, nor probably Taiwan, will inaugurate affirmative action programs for its minorities.

In the case of China, the differences are relatively small in a nation that is likely to remain "poor" for generation to come. One travels southwest to Guilin in Gwangsi province, homeland of the indigenous Miao people, and one sees as much building dynamic as in Xian in the northwest. There is intermarriage between minority/majority populations as population movements bring more Han speakers into contact with these groups. This is a sign that the perceived differences amongst the peoples of China are relatively benign.

Most important for the future of China is its intellectual advantage over its neighbors to the south, an advantage which the Chinese have traditionally bragged about. The Japanese, Chinese, and Korean ethnicities appear to have at least a 5 point I.Q. advantage over the current 20th century European/North American norm of 100. Differential reproductive expansion from the lower reaches of the Caucasoids, has probably reduced the average I.Qs amongst populations of European background. In addition, large minority populations in the United States of lower I.Q., soon to reach numerical parity with the Europeans in the U.S., will likely strengthen the Chinese/Japanese/Korean advantage. The Chinese, in restricting the births to one child per female, have in effect short circuited any possible dysgenic demographic expansion from the bottom of their population profile, as social/economic opportunities and standards of living rise.

If we compare the three northeast Asiatic groups with the Muslim and Arab nations, Latin America, and Africa, we are quick to notice that the northeast Asiatic nationalities are on their way toward the attain-

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ment of democratic polities. The contrast with the chaos and tyrannies which persist in other parts of the "developing" world is graphic. If democracy should build itself on the base of high Chinese intelligence it may be hoped that this might work to vitiate the threat from Chinese militarism.

The Competition

On the other hand, the educable, intellectual profile of the ethnic groups now comprising the traditional Euro-American West, gives one pause when hoping for the continued maintenance of social and political stability. We see already significant class and ethnic differences within a once homogeneous population. This, stemming from fundamental bio/intellectual variance will likely result in class/ethnic conflict, as the old surpluses yield to deficits, unemployment, i.e. hard times.

Trends: The Hispanic population of the U.S rose 58 percent between 1990-2000, while the overall population increase was 13 percent; Whites increased 6 percent, African-Americans rose 15.6 percent. The U.S. Census Bureau predicts that by 2050, 50 percent of the population will be African-American and Hispanic, both of these components today are on the edge of poverty.

In Europe, Turkish immigrants into Austria are producing 4.43 children per female; Austrian nationals 1.64 children per female. Belgian nationals have 1.6 children per female – Turkish immigrants to Belgian=5.0 children per female; Moroccan immigrant females=5.7 children per female. Great Britain nationals 1.7 per female, Pakistani immigrants to Great Britain=5.3 children per female.

French nationals=1.82 children per female. Immigrants to France: Morocco=4.47; Algeria=4.24; Tunisia=4.67; Turkey=4.55. Germany: nationals 1.3 children per female; Turkish immigrants to Germany=2.9 children per female. Netherland: nationals 1.6; Turkish immigrants= 3.1; Moroccan immigrants=4.7. Swedish nationals=2.1 children per female; Turkish immigrants=3.45 children per female. [Coleman, D. A. 1994. "Trends in fertility and intermarriage among immigrant populations in Western Europe as measures of integration," in *Journal of Biosocial Science,* 26:107-136; White, J. B. 1997. "Turks in the New Germany," *American Anthropologist,* 99:754-769.] If present trends

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continue Denmark will be more than 50% Muslem by 2050.

There are some who look to the EU as an economic buffer to Northeast Asiatic productive expansion and power. In the not too distant future the expense of supporting large populations, who need vast amounts of social and economic support, will likely drain the West Europeans of much of their standard of living and productivity advantages of the past fifty years.

Nowhere else in the world is there a region, with the exception of Eastern Europe, Russia, and the Central Asian countries, that might compete with these Northeast Asiatic and their Chinese allies in East Asia. The key is not natural resources, but the ability of people to labor at a high level of intellectual creativity with an extremely modest level of recompense and the stringent standard of living traditional to their history. But even Eastern Europe and Russia have declining populations. By 2050 it is estimated that Russia will have only 119 million people, less than Philippines' 127 million and only just ahead of Vietnam's 117 million, to face China's 1.4 to 1.8 billion.

The West, accustomed to open spaces, is ever more crowded with people, and awaits its inevitable standard of living decline. Think of a future of social instability as a danger to China? Better yet, think of the same danger facing Western Europe or even the United States!

Prospect

Every nation must heed the Biblical injunction of Joseph to Pharaoh, plan for the years of want. Fifty years in these fast moving eras is not too long a span to envision the possible. The Chinese are doing this planning right now. In the days of Mao they sheared off the water-rich portions of Tibet and parts of Kashmir, and planned out and put into reality a truly ambitious project of diverting much of their own water resources to the arid north. Even with the one child per female ordinance, they will be able to shift people from overpopulated regions to the newly available lands in the west and north.

They will have to face up to the problem of wealth accumulation amongst their entrepreneurial classes, considering the egalitarian tradition that the ruling communist party has set forth. They must avoid killing the goose of creative enterprise as they attempt to redirect this

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wealth to the fellowship of Han ethnicity, perhaps by the growth of the foundation principles that the Protestant elite exemplified in the United States.

Widely distributed Chinese intelligence and educability, and their willingness to work hard for sub-American and European recompense, will destroy Western manufacturing and all those industries that can move over the borders, e.g. software information processing to India. The U.S. inability to compete in manufacturing, and perhaps soon in the fields of creative technological and medical research, could convert the U.S from a leader into a backwater of scientific/technological innovation. In those areas, for centuries the home ground of the Western nations, East Asia is on the way towards humbling the sense of dominance and smug security which still persists in the West. One sees this oncoming dominance of the East Asiatics in the departments of technology, engineering, and science in American universities, as also in the research labs of the great corporations.

The control over the water resources of south and east Asia will enable the Chinese to create alliances and economic spheres, such as the Japanese imperialists attempted in the 1930's-1940's. Only this time, four or five decades down the line, the economic heft which currently finances the military superiority of the United States will belong to China. With the vast, open spaces of Russian Siberia and Central Asia but poorly protected by Russia, and with Pakistan and India bogged down by a suffocating demographic explosion (India is projected to have a population of over 1.6 billion by the middle of the century, Pakistan 350 million, and tiny Bangla Desh, over 250 million) and inter-group conflicts, the geo-political future of China, rooted in the high level of educability of its citizenry, as the only world "superpower" circa. 2050, seems virtually assured.

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Book Reviews

The Illusion of Victory:
America in World War I
Thomas Fleming
Basic Books, 2003

As the title indicates, this book is more than a detailed scholarly history. It is also a work of hard-hitting analysis. Thomas Fleming has written an extended essay about American involvement in World War I that gives an informative factual account while also expressing a definite point of view.

His perspective runs counter to the conventional wisdom that reveres Woodrow Wilson and counts him as among the best of American presidents. In Fleming's account, Wilson emerges as a man who, although deeply caring and confident, is uncompromising, vindictive, naïve, duplicitous, craving of fame, and utopian.

Fleming has written more than twenty books. These include several histories and biographies on a variety of subjects, as well as nine works of fiction. When he writes about the "illusion" that the United States was a victor in World War I, however, he has something of a personal stake in the subject: his father, a sergeant in the 78th Division, received a battlefield commission when all the officers of his company were killed or wounded.

The American intervention into World War I is arguably the most pivotal event of the twentieth century. Before leading the country into war, Wilson, he says, first pursued a period of "sham neutrality" that applied a double standard to the British and Germans. Fleming ponders what would have happened if the United States had followed a true neutrality that would not have provided abundant material support to the Allies.

He concludes that "the war might have ended in 1916 with a negotiated peace based on the mutual admission that the conflict had become a stalemate." Had this occurred, the stage would have been set much differently for the rest of the century than it turned out to be. Among

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countless other things, millions of lives would have been spared, Europe would not have depleted itself internally and on the world stage, the Treaty of Versailles with its aftermath of national socialism in Germany would not have come about, there would have been no Second World War, and Russia would not have fallen under the sway of the Marxism-Leninism that towered over the world for seventy-some years and itself took millions of lives. Without Communism in Russia, it is doubtful that Mao would have conquered China and that the Korean and Vietnam wars would have come about.

Some readers will be content to value the book merely as an excellent chronicle of the war years and of Wilson in the context of the politics and personalities of the time. Its greater worth, however, lies in its analysis. It has much to teach.

In a final chapter summarizing his conclusions, Fleming comments about the messianic utopianism that we know today is central to the debate about the United States' role in world affairs. Fleming sees it as foolish and dangerous: "Idealism is not synonymous with sainthood or virtue. It only sounds that way. The most dangerous aspect of American idealism is its tendency to become utopian, to propose as ideals a foreign policy or political reforms or a world order that ignores the realities of the way men and women – and nations – live and prosper."

He then refers to "utopian derangements." This goes to the heart of the matter. Much of the thrust of the book has been to show the vast extent to which the messianic outlook of the Wilson administration and, through it, of much of the American people was based on misinformation, disinformation, myth, and conceptual blindness. *The Illusion of Victory* may be seen as a case study in the folly that seems so chronically a prime mover in much that humanity does.

The derangement that Fleming speaks of is seen in the clichés that prevailed in Wilson's thought:

1. *"Democracy."* Wilson famously said "the world must be made safe for democracy," which was to be accomplished by defeating the German threat. There was, however, no consensus for "democracy" either in the world in general or among the major powers, as was evident at the time and was made clear during the decades that followed. A similar, though arguably much worse, self-deception occurred later when the United

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States allied itself with Stalin in fighting Hitler, doing so in what seemed a moral crusade on behalf of all that was right. Democracy dominated the rhetoric, but was divorced from the reality.

Fleming is correct in pointing out this illusion. It is worth noting as an aside, however, that Senator LaFollette overstated it when, as paraphrased by Fleming, he asked: "Had the British shown the slightest interest in extending democracy to Ireland, to Egypt's millions, to India's hundreds of millions?" This repeats some gross over-simplifications about Britain's role in each of those places. (Egypt, as one example, was never a British colony, but rather was something of a protectorate. In that role, it was not Britain's responsibility to transform Egypt into a democracy.)

2. *"Militarism."* Illusion again applies to the image of Germany under the Kaiser as unspeakably militaristic. Fleming points out how during the Napoleonic era (a mere century before) it was France that had shown a "love of military glory and lust for conquest." Britain, not Germany, had the world's largest fleet. The "militarism" charge was reinforced by the Allies' demonizing the Kaiser, who liked to dress up in military regalia, and whom they called "a megalomaniac with a hunger to rule the world," as well as "the Mad Dog of Europe" the "the Beast of Berlin." Fleming points out how incongruous this was in light of the *New York Times'* headline in 1913, just the year before World War I: "Kaiser, Twenty Five Years a Ruler, Hailed as Chief Peacemaker." Fleming says "the accompanying story called Wilhelm 'the greatest factor for peace that our time can show.'"

3. *"Germany planned to dominate the world."* In tandem with the "militarism" aspect, a central feature of Americans' "war rage" was the image of Germany as a behemoth that was out to dominate the world. Wilson wrote that "the object of this war is to deliver the free peoples of the world from the menace of a vast military establishment controlled by an irresponsible government, which, having secretly planned a dominate the world...." But in a speech in Saint Louis, Wilson later made what Fleming calls "a baffling remark" in total contradiction to the "domination" thesis: "This was, in its inception, a commercial and industrial war. It was not a political war."

4. *"Germany started the war."* It was the claim of exclusive war guilt,

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solemnized within the Treaty of Versailles, that so greatly infuriated Germans and contributed to the anger that was manifest in Hitler's national socialism. Fleming calls it a "bizarre accusation." "No one claimed that the Germans had shot Archduke Franz Ferdinand and his wife in Sarajevo in 1914, nor that this murder... did not have a great deal to do with precipitating the conflict. The war guilt clause pretended this central event never happened." The debates among historians since 1914 show that there is a great deal of complexity to the "war guilt" issue. Germany's culpability, as especially its "sole" culpability, is disputed by many of those who have studied the issue.

5. *"Neutrality."* Wilson railed against German submarine warfare and insisted that Americans had a right to travel on British ships in the war zone. But he did nothing effectual to protest the British blockade that so thoroughly choked off Germany's supplies and created the desperate expedient of unrestricted submarine warfare to counter it. Fleming says "Wilson talked – and talked and talked – about neutrality," but that the United States evolved "into a branch of the British armament industry during the thirty-two months of its neutrality."

6. *"Self-determination."* Wilson's naivete and idealistic over-simplification was perhaps best shown by his principle of "self-determination" that was included among his 14 Points. Fleming says "the idea had opened a Pandora's box that would be difficult if not impossible to close. Albanian warlords, tribal chieftains from obscure valleys in the Caucusus and Carpathian mountains, would-be politicians from Armenia, the Ukraine and Bessarabia appeared... seeking redress and recognition." Needless to say, these examples barely scratch the surface. As it turned out, the peace conference declared "mandates" that "handed over some 17 million people to the victorious Allies." "The British acquired Palestine and Iraq, and the French got Syria and Lebanon." What Fleming forgets, perhaps, is that there was little profit in these mandates (except, for a time, the opportunity to develop the oil wealth of Iraq, which investments were lost to Britain without compensation after that country was deemed ready to manage its own affairs), but considerable onerous and costly responsibilities, notably, in the case of Palestine, when Jewish refugees began to pour into that country from Europe following the Allied victory in World War II.

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7. *"Open covenants, openly arrived at."* Fleming said Wilson lied when he told the Senate Foreign Relations Committee that he had not known of the other Allies' secret treaties before he arrived in Europe for the peace conference. And the "open covenants" principle was immediately shunted aside when "the press... found themselves barred from all sessions of the Council of Ten (the Big Five and their foreign ministers)" at the peace conference.

8. *"A war to end all wars."* The irony of the claim to be ending all wars is shown by world history since 1919, but it is enough to point to the fact, as Fleming does, that in early 1919 "there were no less than fourteen small wars in progress in supposedly pacified Europe" as "armies began shooting at each other over disputed slices of territory."

There is much, much more in Fleming's account. Although the book's title speaks of "illusion" and Fleming refers to "derangement," he does not bring out the points for separate discussion as we have done here. He presents them, instead, as parts of a vast tapestry. The history of World War I, its causes and consequences, is a matter of great importance about which all educated people would do well to reacquaint themselves. Almost ninety years have passed since that war began, and we are hopefully better able by this time to take an objective look at it.

Dwight D. Murphey

Cosmic Legacy:
Space, Time, and the Human Mind
Greg F. Reinking
Vantage Press, New York, 2003 ISBN 0-533-14027-7

In this truly remarkable book, synthesizing contemporary information on space, matter, time and the human mind, the author documents in highly comprehensible language what is known and what can be theorized about the origins and nature of the universe, time and mankind. Human neurological development and theories of consciousness, intelligence and human behavior are discussed against a backdrop of the vast powers at work in the Universe, the age of which was

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estimated as recently as February 2003 at 13.7 billion years, with a one percent margin of error, on the basis of microwave background radiation.

The author, Greg Reinking, is well equipped to attempt to enlighten us on these great mysteries. His academic career began in the field of electrical engineering, following which he conducted research in Molecular Physics at the Oak Ridge National Laboratory, and then studied medical physics at UC Berkeley. After training in surgery and radiology, he completed Harvard University fellowships with the Diagnostic Neuroradiology and Interventional Neuroradiology groups at Massachusetts General Hospital, and has authored numerous articles in scholarly journals in the areas of physics and medicine.

Pointing out that all terrestrial life is derived from star dust collected from the cosmos billions of years ago, the author is able to relate biogenesis, cognition and intelligent reasoning to final realities such as the nature of matter, time and space. To quote from his closing chapter:

> The evidence clearly points to a Universe that began in a hot, dense form. We don't fully understand the properties in effect at the beginning – our current concepts of physical laws break down at the extreme conditions presumably existing the beginning, precluding our ability to describe those early moments. Thus we must assume that the Universe was in a completely different form at that time, which defies our ability to explain it. Several theories point to a linkage among matter, energy, space, and time, suggesting these ordinarily discrete properties may have (at the beginning of the Universe) been combined in a single form. In fact, the distortions of matter, space and time were so extreme that time may have lost its identify – blurring the meaning of a beginning in the conventional sense of time. Furthermore, the surprising complexity of the vacuum of space, once considered empty and dull, may in fact hold the key to unifying these properties. This vacuum, which surrounds us, permeates us, and occupies the vast majority of the Universe, is the realm of quantum particles and their forces – it acts as a medium that transmits the forces of gravity and electromagnetism. Hidden within this vacuum may be the infinitesimal remains of multiple dimensions of space, curled upon themselves since the genesis of our Universe. These infinitesimal dimensions may define the laws of nature, which govern everything that exists.

Organic life requires only a few elements, which are relatively abun-

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dant in the universe, but they must be organized in highly complex and consequently unstable compounds, and the conditions on the Earth which gave rise to the coordinated collective biochemical processes which we call life were very different from those of today. The Earth was then relatively cool and enveloped by a thick, damp atmosphere composed of hydrogen, methane, ammonia and water vapor, with very little atmospheric oxygen, this having been put into the atmosphere subsequently by plant life-forms. The primeval atmosphere also lacked ozone, so that the earth was bathed in ultraviolet radiation, which may have contributed to the formation of the earliest biomolecules.

The combination of conditions which permitted intelligent life to come into existence probably were the result of a chance "throw of the dice" when the dice were thrown multitudinous times. The idea that there may be a "great order in the Universe," the product of some intelligent architect, is discarded by the author, who sees only a grand chaos.

Evolution took place along the lines that are now widely appreciated, but as Reinking points out, the evolution of humanity occurred amongst small groups of hominids widely dispersed under different selective conditions. Will humanity continue to evolve with the same rapidity? He thinks not, because as the increasingly large human population becomes homogenized into a single genetic mass future evolution will necessarily be slowed – unless further speciation is created artificially by conscious genetic manipulation. Advances in medical science offer the possibility of guided human evolution, otherwise known as eugenics, should the political will to accept such a path be present. Certainly susceptibility to genetic disease could be sharply reduced.

As for the possibility that Mankind may in the future successfully explore the boundaries of the Universe, the author warns that "the evidence suggests our Universe lies within its Schwarzschild radius – we are essentially inside a vast black hole, precluding any opportunity to explore what lies outside." Indeed, our present knowledge implies the ultimate disappearance of all life forms anywhere they might exist in the Universe. It is estimated that in about one trillion years the stars will burn out, collapsing into either white dwarf stars or black holes. Black

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holes will become more common than they now are, until they are swept into larger core black holes, while the universe continues to expand. Energy may again be released as the black holes themselves eventually disintegrate, "creating a fireworks finale lasting billions of years, marked by occasional flashes scattered throughout a vast abyss. As the Universe expands further, its temperature will continually fall as it approaches absolute zero, leaving the Universe infinitely large, completely dark, and absolutely cold."

That remains a purely speculative forecast, of course, but it is a prophecy based on the evidence currently available to us.

All philosophers who pontificate on the nature, character and future of Mankind and human society should familiarize themselves with the latest findings of science. For the intelligent reader, Reinking's *Cosmic Legacy* is a concise but graphic 390 page introduction (with a useful glossary for the lay reader) to the very latest that science can tell us about space and man's infinitesimally small place in the Time and the Universe, whatever Time and the Universe might be.

J. W. Jamieson

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INDEX TO VOLUME TWENTY-EIGHT

Bahgat, Gawdat
The New Middle East:
The Gulf Monarchies and Israel 123
Proliferation of Weapons of Mass Destruction:
Iraq and Iran 423
Bolatito, A. Lanre-Abbas
Feminism in the Postmodernist Age 355
Cooper, Ambassador Henry F.
Defending America from Offshore Missile Attack 31
Dima, Nicholas
The Black Sea Region:
New Economic Cooperation and Old Geopolitics 77
Graber, Robert S.
Management turnoverand Under-Investment in R&D:
An Agency Theory Explanation for Under-Investment
in Research and Development in some Corporations 295
Hassan, M. Kabir, M. Waheeduzzaman and Aminur Rah
Defense Expenditure and Economic Growth
in the SAARC Countries 275
Heiss, Klaus P.
Some Thoughts on the Columbia Disaster
and How to Proceed from Here 389
Immerman, Ronald S. and Wade C.Mackey
The Feminist Paradox:
An Index of Cultural Evolution 217
Itzkoff, Seymour
What Kind of Aid for a World in Want? 97
China – Emerging Hegemony
A Speculative Essay 487
Looney, Robert
Reforming Pakistan's Educational System:
The Challenge of the Madrassas 257
Mackey, Wade C. and Ronald S. Immerman
An Examination of Gender Asymmetry in Divorce:
an Extension of Fisher's Thesis 451

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Mowthorpe, Matthew
The United States Post Cold War Military Space Policy 3
The UK's Aircraft Carriers and their Rationale 153
Murphey, Dwight D.
Understanding America: The Martin Luther King Myth 325
Scott, Ralph
Five Decades of Federal Initiatives concerning School Desegregatory Effects: What have we learned? 177

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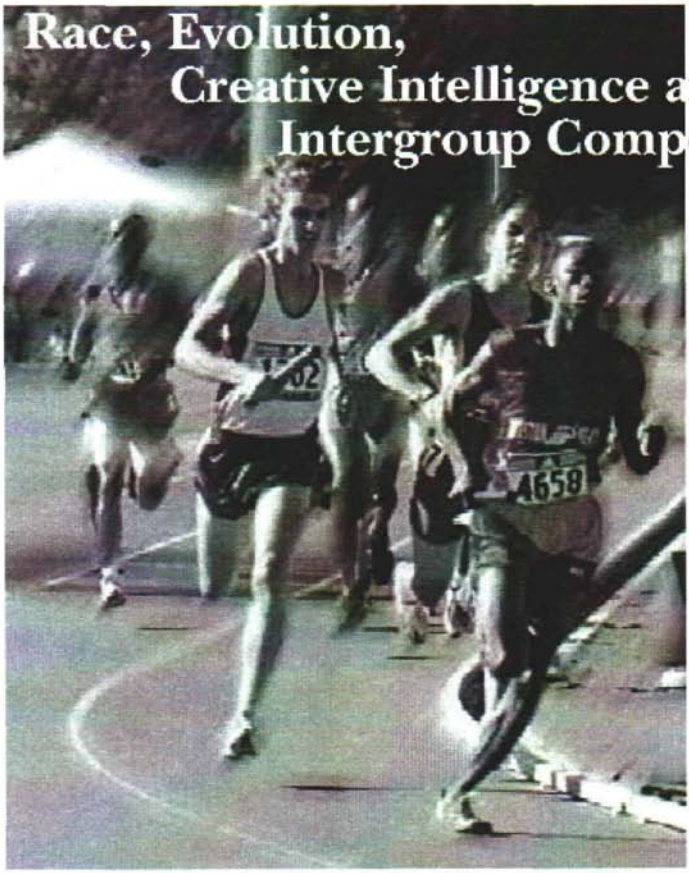

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